Asia-Pacific
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APEC SYMPOSIUM ON INDUSTRIAL CLUSTERING FOR SMES

8-9 March 2005
Taipei International Convention Center, Taipei
Chinese Taipei

APEC Small and Medium Enterprises Working Group

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8-9 March 2005
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Agenda
（Drafted as of March 3, 2005）

Background Paper

March 7 (Mon)
Afternoon
12:00-19:00 Registration (Taipei International Convention Center)
19:00-21:00 Welcome Party / Culture Show (Taipei 101) (Map)

March 8 (Tues)
Morning
8:00-9:00 Registration (Taipei International Convention Center)
9:00-10:20 Opening Session

WELCOME REMARKS:

Steve Ruey-Long CHEN, Deputy Minister, Ministry of Economic Affairs, Chinese Taipei

Seok-young CHOI, Executive Director, APEC Secretariat
Welcome Remarks by Ambassador Seok-Young CHOI

KEYNOTE SPEAKERS:
Steve Ruey-Long CHEN, Deputy Minister, Ministry of Economic Affairs, Chinese Taipei
Topic: Creating a Favorable Environment for SMEs Industrial Clustering

David AUDRETSCH, Director, Max Planck Institute for Research into Economic Systems, Jena, Germany and Ameritech Chair of Economic Development, Indiana University, USA
Topic: Entrepreneurship, Cluster Formation and the Strategic Management of Places (PowerPoint file)

Michael J ENRIGHT, Professor of Business Administration, University of Hong Kong, Hong Kong
Topic: Regional Clusters: New Departure and Paradigms
The 8th Annual Global Conference of The Competitiveness Institute

10:40-12:00
PLENARY SESSION: Conditions for the Formation of a Successful Industrial Cluster in the APEC Region
Chair: *David AUDRETSCH, Director, Max Planck Institute for Research into Economic Systems, Jena, Germany and Ameritech Chair of Economic Development, Indiana University, USA*

Speakers:
Michael J ENRIGHT, Professor of Business Administration, University of Hong Kong, Hong Kong
Topic: Fostering Regional Clusters

Kio Chung KIM, Asian Pacific Women's Information Network Center, Korea
Topic: Clustering and Informatization on Women Enterprises
Ref1: AP Estate Corporation Business Plan
Ref2: SAMPLE, Some graphics and text taken from Century21 website

Tain-Jy CHEN, President, Chung-Hua Institution for Economic Research, Chinese Taipei
Topic: The Success Factors for an Industry Cluster: Experience of the Hsinchu Science Park (PowerPoint file)

Dieter ERNST, Senior Fellow and Professor, East-West Center, Honolulu, USA

Topic: Complexity and Internationalisation of Innovation-Why is Chip Design Moving to Asia? (pdf file)

12:00-13:20
Luncheon (Taipei International Convention Center)

Afternoon

13:20-14:40
PLENARY SESSION: Interactions of Industries, Academia and Research Institutes in an Industrial Cluster

Chair: Johnsee LEE, President, Industrial Technology Research Institute, Chinese Taipei

Speakers:
German Echecopar KOECHLIN, Professor, Center for Entrepreneurship, Universidad Adolfo Ibanez, Chile
Topic: Innovation in the Chilean Information Technology Sector (PowerPoint file)

Roger WIGGLESWORTH, Director of the SMEs Division, Ministry of Economic Development, New Zealand
Topic: The Role of Government in Supporting Collaboration and Interlinkages

Deuk Kyu BOK, Senior Researcher of the Samsung Economic Research Institute, Korea
Topic: The Impact of Network Structure on Corporate R&D Investment

Simone TANI, Consultant , OECD
Topic: University Focused Clusters of Innovative SMEs. Evidencies of Experiences and Emerging Patterns from Tuscany

15:00-16:20
PLENARY SESSION: A Liberal Trade and Investment Environment for Promoting International Linkages Among Clusters

Chair: David S. HONG, Vice President, Taiwan Institute of Economic Research, Chinese Taipei

Speakers:
Bor-Wen KRENG, Professor, Dept. of Industry and Information Management, National Cheng Kung University, Chinese Taipei
Topic: International Industrial Clustering - A Global Value Chain Perspective

Tomoo MARUKAWA, Associate Professor, Institute of Social Sciences, University of Tokyo, Japan
Topic: Automobile Industry Clusters in China (PowerPoint file)

Khee Giap TAN, Head, Central Banking Polices Research Unit, ASEAN / Professor, Nanyang Technological University, Singapore
Topic: Small and Medium Enterprises in Singapore and Strategies for Regional Cooperation and Integration: Policy Lapses, Lessons Learnt and Challenges Ahead

Kalsom Abdul RAHMAN, Chairman, Small and Medium Industries Development Corporation, Malaysia
Topic: A Liberal Trade and Investment Environment for International Industrial Clustering (PowerPoint file)

16:40-18:00

PLENARY SESSION: E-commerce and Industrial Clusters

Chair: Chin-Ho SU, President, Corporate Synergy Development Center, Chinese Taipei

Speakers:
Charles STEINFIELD, Professor, Department of Telecommunication, Michigan State University, USA
Topic: When do SMEs Benefit from E-Commerce in an Industrial Cluster? Evidence from a Biotech Cluster (pdf file)

Bordin RASSAMEETHES, Professor, Faculty of Business Administration, Kasetsart University, Thailand
Topic: Building an I-community: The New Asia Imperative for Social Development (PowerPoint file)

C. K. FARN, Professor, National Central University, Chinese Taipei
Topic: Promoting E-commerce in SMEs with Programs that Leverage on Industrial Clusters: The Case of Chinese Taipei

Wong Siew HAI, Director of RosettaNet Malaysia, Malaysia
Topic: Linking Up SMEs for Survival: via Electronic Supply Chain and Cluster Management

March 9 (Wed)
Morning
9:00-10:40

PLENARY SESSION: How SMEs Benefit from Industrial Clusters in the APEC Region

Chair: York Yaw-Chung LIAW, Deputy Director General, Small and Medium Enterprise Administration, Ministry of Economic Affairs, Chinese Taipei

Speakers:
Ivan Ornelas DIAZ, Director for International Affairs, Ministry of the Economy, Mexico
Topic: HOW SMEs BENEFIT FROM INDUSTRIAL CLUSTERS IN APEC REGION

Sandra van HULSEN, Director, Van Hulsen Consulting, Harderwijk, the Netherlands
Topic: How SMEs Benefit from Industrial Clustering in Peru; A Case Studies from the Metalworking Sector (PowerPoint file)

Patrice BRAUN, Professor, University of Ballarat, Australia
Topic: Small Business Clustering: The Benefits of Local Network Learning (PowerPoint file)

11:00-12:00

Concluding Session: Best Practices on Industrial Clustering in the APEC Region
Chair: Mignonne CHAN, Research Fellow, Division of International Affairs, Taiwan Institute of Economic Research, Chinese Taipei

Each session chair has ten minutes to report the concluding remarks for his/her session.

12:00-13:20 Luncheon (Taipei International Convention Center)

Afternoon

13:20-18:00
Field Trip
Group A:
Nankang Software Park & Biotechnology Incubation Center

Group B:
Handicraft Promotion Center & C.K.S. Memorial Hall

Background Paper for

APEC Symposium on Industrial Clustering for SMEs

March 7–9, 2005, Taipei, Chinese Taipei

Small and Medium Enterprise Working Group,

ASIA-PACIFIC ECONOMIC COOPERATION

(APEC)

Executive summary

This background paper for "APEC Symposium on Industrial Clustering for SMEs" focuses on the innovation capabilities of SMEs incubated in industrial clusters with an overview of the development experiences of selected industrial clusters. This event brings together leading experts, business leaders, and government officials to share experiences and views with one another on an agenda of industrial clustering related issues. Eventually, the event can provide best practices on industrial clustering for SMEs in the region. Five themes discussed by the symposium will include: (1) the conditions for the formation of a successful industrial cluster, (2) the linkages of industries, academics, and research institutes in an industrial cluster, (3) a liberal trade and investment environment for international industrial clustering, (4) E-commerce and industrial clusters, and (5) how SMEs benefit from industrial clusters.

Table of Contexts

1. Introduction

It is well-recognized that Small and Medium-sized Enterprises (SMEs) create most of the employment in the APEC region and represent the backbone of regional economic growth. The main objective of the Small and Medium Enterprises Working Group (SMEWG) under APEC is to encourage the development of SMEs in the region. Innovation is underlined as one of the practical solutions for SMEs to cope with current rapid changes in the global competition. As with the statement in the theme for the 2005 SME meetings, the internal factors for driving the development of SMEs, such as competitiveness and capacity building, are stressed upon. Along the line with entrepreneurship, which served as the theme of the SME Ministerial Meeting (SME MM) for two consecutive years since 2003, promoting innovation capabilities of SMEs has been highlighted as an issue for the year 2005.

In recent years, knowledge has emerged as a source of competitiveness and entrepreneurship, and also offers a new model for conquering poverty and ensuring economic development. Entrepreneurship has also become an engine of economic and social development throughout the world. Small entrepreneurial firms play more important roles in the knowledge-based economy, in which they account for a disproportional share of new product innovation given low research-and-development inputs.

Policies toward promoting entrepreneurship and innovations are based on the market failure associated with related knowledge activities (Audretsch, 2003: p. 34). Especially in the pursuit of SMEs' innovation capabilities, generating a favorable environment for innovation is one of the policy concerns. Three priority strategies are underlined: (1) human resources and technology development through industry and academia linkage, (2) enhancing the availability of capital to innovative SMEs, and (3) networking and clustering for innovative SMEs. Human resources, technology, and capital are regarded as the three key but traditional elements for SMEs' innovation activities. Because system failure has been underlined for the recent two decades, establishing a linkage between industry and academia, and promoting networking in industrial clusters within and across borders would offer synergy effects for innovations and more chances, while lowering risks.

The event, entitled "APEC Symposium on Industrial Clustering for SMEs," aims to construct a dialogue among the APEC member economies on important issues related to a knowledge-based economy. On the behalf of the Asia-Pacific Forum, the event is hosted by the Small and Medium Enterprise Administration under the Ministry of Economic Affairs, Chinese Taipei. The symposium, held March 7–9 2005, will bring together leading experts, business leaders, and government officials to share their experiences and viewpoints on SMEs' innovations and industrial clustering with one another. The main issues addressed in the symposium are as follows:

1. The conditions for the Formation of a Successful Industrial Cluster.
2. The linkages of industries, academics, and research institutes in an industrial cluster.
3. A liberal trade and investment environment for international industrial

clustering.

4. E-commerce and industrial clusters.
5. How SMEs benefit from industrial clusters.

The effect of industrial clusters upon the enhancement of industrial innovation capabilities has been underlined. Some successful experiences of industrial clusters under cluster-based policies are available to drive the innovative capabilities of firms, especially SMEs. To the extent of a global economy, cross-country policy coordination - as the precondition of effective cluster-based policies - is beneficial to the flows of capital, human resources, and knowledge towards the formation of an industrial cluster.

2. Rationales behind the Themes

Over the past two decades there has been an international surge of analytical and policy interest in the "global economy," featured by the integration of a global market, but with geographical disintegrations of a production chain deployed in limited industrial clusters. The arrival of a global economy underlines the opportunities and challenges to SMEs, especially in the APEC region. It is hard for most SMEs to survive under global market competition only with their own limited resources and specialized skills and technological capabilities alone. In the era of a global economy, an industrial cluster plays a critical role in enforcing the competitiveness of SMEs through forming production networks, and driving business specialization and knowledge sharing.

On the one hand, within an industrial cluster, the competence and innovation of SMEs are strongly supported by regional or local business networking in which SMEs specialize in a limited range of businesses and join in the social division of labor. Since most SMEs heavily depend on their own market segment or niches, the integration of a global market cannot threaten their existing base and competitive strength, yet even may provide them with potential market opportunities and business partners in unknown countries or territories. The benefits of clustering must also be associated with the reduction of transaction costs when firms co-locate, including search and information costs, bargaining and decision costs, as well as policing and enforcement costs (Dahlman, 1979). The co-location of firms imposes certain constraints on their behavior, making it easier to conduct businesses with one another. Co-localized firms realize the unattractive consequence of breaking the rules and will refrain from doing so. In a cluster it will be immediately noticed if some firms attempt to over-utilize asymmetric information, or pass substandard goods as premium grade, or create hold-ups in order to exploit market shortages. Behavior of this kind puts firms on “black lists,” which deprives them from information and trading opportunities. Through this sanction mechanism, co-localized firms therefore create a mutual understanding and trust that reduces malfeasance and facilitates trade. Clusters prevail, because trust cuts the costs of identifying, accessing, or exchanging products between members in the area (Maskell, 2001).

In addition to specialized suppliers, Marshall (1890) also pointed out two other causes of agglomeration effects: labor pooling and technology spillover. Labor pooling refers to the presence of a labor force suitable for the particular industry in the cluster. Labor pooling reduces the entry barriers to new firms, the exit costs of incompetent firms, and the costs of adjusting the scale of production. Labor pooling also acts as a selection mechanism that stores or even cultivates a work force to support the growth of the industry. Using data on the U.S. manufacturing industry, Rosenthal and Strange (2001) found labor market pooling to be the most robust influence on agglomeration. Dumais et al (1997) also found that industries with a similar labor mix enjoy the greatest benefit from co-location.

On the other hand, a cluster is a congregation of interrelated industries and institutions that create complementary linkages in the exploration and application of knowledge. The ability to innovate continuously underlines the competitiveness of a firm, and industrial clusters are known to be conducive to the establishment of such an ability. “Clusters encompass an array of linked industries and other entities important to competition, including governmental and other institutions such as universities, standard-setting agencies, think tanks, vocational training providers, and trade associations” (Porter, 1998). The basic reason for clustering is that the co-location of firms generates a positive externality on productivity. Positive externality is most prominent when firms are “interconnected.” As suggested by Marshall (1890), when parallel but dissimilar firms co-locate in a region, they develop a variety of solutions to the same problem, based on the same information but different perceptions and different spheres of competence. This idiosyncratic and partly tacit way of dealing with things allows firms along the horizontal dimension of a cluster to engage in the process of mutual learning and a competing improvement, on which their survival depends (Maskell, 2001).

As we have noted, the collective nature of an industrial cluster provides firms with certain advantages that shape and drive competitiveness both nationally and globally. These advantages are often realized in the form of agglomeration externalities, three types of which have been classified by Glaeser et al. (1992). The first type is the Marshall-Arrow-Romer externality, which highlights industrial specialization within a region. This externality enables each firm participating in an industrial cluster to reduce investment costs by allowing it to specialize in a narrow segment of the total value-added chain. Smaller firms within clusters find ways to differentiate themselves, occupying unique market niches that have not yet been exploited, and together securing large contracts that could not be filled by any single firm alone. This process fosters competition, collaboration, and innovation, enhancing the long-term prospects of success for small businesses that become part of a dynamic cluster.

The second type of externality is the Porter type, which arises from regional specialization and product differentiation. This externality stems mainly from local rivalry between firms, which further fosters the rapid diffusion of knowledge and the adoption of new ideas. In addition, the development of industrial clusters may lead to simultaneous competition and collaboration in the provision of innovative products and services, and to the establishment of sustainable competitive advantages in such areas as technology, workforce quality, production methods, delivery time, and resource procurement.

The third type is the diversity externality, which is stimulated by an interchange of ideas between businesses within a region. As noted in Jovanovic and Rafael (1989), these ideas are often derived from heterogeneous knowledge arising across firms and people.

By providing access to a common source of research, innovation, knowledge, and other industry-specific assets, industrial agglomeration externalities enable business firms to enjoy a faster pace of growth and a higher level of competitiveness. Entrepreneurship may also be regarded as the linchpin tying together all the diverse forms of networking activity present within a dynamic industrial cluster.

Most recent research provides evidence highlighting how industrial clusters generate positive effects on regional firms. (1) Baptista and Swann (1999) show how the formation of an industrial cluster can effectively reduce entry barriers and facilitate market entry. (2) Gemser and Wijnberg (1995) and Baptista and Swann (1998) indicate that industrial clusters enable firms to be more innovative. (3) Storey (1994), Barkham, et al. (1996), Lechner and Dowling (2000), Lechner and Dowling (2003), and Hoogstra and Dijk (2004) provide evidence that regional environments matter in driving firms' growth. Technology spillover is also found empirically to be an important contributing factor to the geographic concentration of firms. Innovative activity itself is substantially more concentrated geographically than overall production, and industries that emphasize research and development tend to be more spatially concentrated than those that do not (Audretsch and Feldman, 1996). Technology spillover does contribute to agglomeration, but its effect diminishes rapidly over distance (Rosenthal and Strange, 2001). Thus, firms have to be close enough to the knowledge center to benefit from knowledge spillover.

On the extent of sustaining SMEs, industrial clusters can be an important vehicle for driving the entrepreneurship by taking the advantages of regional production networking and knowledge sharing. Embedded within an industrial cluster, such external networks provide regional firms with supply chain linkages, common technologies, a customer base, and a pooled labor market, connecting neighborhood-based firms with the economies of other regions and even with the global economy. An industrial cluster reduces risk by helping to lower costs faced by business firms. By linking suppliers with users of market inputs, an industrial cluster can create knowledge spillover effects, reducing barriers to market entry and further incubating entrepreneurship. One way in which it accomplishes this is through the process of labor pooling, which diminishes the costs associated with hiring and discharging workers, especially skilled workers and managers. Moreover, by facilitating the dissemination of industry-specific technical information, industrial clusters enable entrepreneurs to avoid making expensive mistakes in the start-up phase of enterprise formation. Industrial clusters nurture the development of economic actors closely tied to one another through shared technological narratives, mutual trust, and a willingness to cooperate (Solvell and Zander, 1998:409). Emerging from universities, government-sponsored research institutes, and/or other R&D-intensive environments, such actors help spur the diffusion of new technology from the laboratory to the workplace.

In short, there are a number of distinct advantages for firms involved in the formation of an industrial cluster. To reiterate, these include firstly, that a cluster provides complementary resources such as technology and information exchange, management assistance, and so on, to improve the performance of all firms, including SMEs, within the cluster. Secondly, the cluster strengthens competition and thus promotes technical efficiency, because as firms are located nearby, the inherently fierce competition for clients or suppliers becomes unavoidable; nevertheless, competition inevitably pushes up the level of efficiency. Thirdly, firms can quickly respond to the demands of the market or to changes in technology, since firms within the cluster can reorganize subcontracting work more quickly than those outside of the cluster. This particular ability to leverage resources to adapt to fluctuations in the market and changes in technology has been the major benefit for firms located within the cluster.

3. Overview of Selected Industrial Clusters in the APEC Region

As addressed in the opening section, the arrival of a global economy makes cross-border cooperation be hugely critical in promoting industrial clusters in the APEC region. Even though the background among APEC member economies is significantly different, the interchange and sharing of experiences of industrial clusters in the APEC region are still meaningful for driving regional cooperation.

The questions addressed in the section are as follows: What is the historical background and what have been the major incentives behind the formation of clusters by large firms and SMEs? How do clusters interact with other clusters? Have they been able to adapt to the more open, internationalized environment that has emerged in recent years? Finally, how do clusters benefit from firms' innovation capabilities? All of these questions, and perhaps countless others, are worthy of further exploration. Therefore, some case studies – Chinese Taipei's Hsinchu Science-based Industrial Park (HSIP), Silicon Valley in the U.S., Malaysia's Penang and Kelang Valley clusters, and the Hamamatsu cluster in Japan – are introduced in an effort to gain an understanding of, and to draw some lessons from, their developmental experiences.

3.1 Hsinchu Science-based Industrial Park (HSIP)

Following the first oil crisis in 1973, the government realized that Chinese Taipei's industrial development was built on a weak, labor-intensive structure, which was liable to disintegrate during any protracted period of recession. It was clear that Chinese Taipei needed to pursue a policy of development of hi-tech, high value-added industries, and in order to attract investment and technology transfers from foreign hi-tech industries, the government had to provide a suitably attractive environment. It therefore decided to create a science-based industrial park similar to the well-established example of Silicon Valley in California.

When deciding on the location for the new park, the availability of highly-skilled manpower and technical support were vital preconditions, and Hsinchu was seen as a prime target, with its two universities – National Tsing Hua University and National Chiao Tung University – being particularly strong in sciences, and thus ensuring that there would be no shortage of skilled workers. One additional issue, the fact that the Industrial Technology Research Institute (ITRI), an organization created to provide much needed technological support, had already been established in Hsinchu, made Hsinchu the obvious choice.

With the effective provision of manpower supply, and other incentive measures for land purchase and building construction having been created, the government formally established the HSIP in 1980. In the previous year, the Statute for the Science-based Industrial Park Establishment and Administration (1979) had been promulgated, providing, in Article 15, five-year tax holidays for companies establishing themselves within the park, along with exemptions from import duties, commodity taxes, and business taxes for imported equipment, raw materials, parts and semi-finished products imported from abroad (Article 17), and a variety of other tax incentive measures.

The whole concept behind the establishment of the HSIP represented the creation by the government of a space where industry could gather and group together, enabling manufacturers to reduce the costs of personnel training, buildings, land, and other basic infrastructure, while also allowing them to enjoy the benefits of a concentration in technology transmission (Mai, 1996; Mai and Peng, 1999). In addition, the tax incentives also clearly had the effect of encouraging manufacturers to invest within the park.

The HSIP was founded in 1980 to start its joint venture stage, as guided by government policy. Following its establishment, only 14 companies gained approval for their relocation into the industrial park between 1980 and 1987, with the total amount of investment at that time being NT$1.24 billion. The mainstream development of the park at that time fell into the category of computers and peripherals, with only 4,090 of the employees within the park being technical personnel. During this stage, the main dynamic of the park's emerging technical development came from the government statute and the introduction of foreign technologies by the ITRI.

In the dynamic growth stage, which commenced in 1988, the Chinese Taipei Mask Corporation started manufacturing optical masks, while in the same year some companies also started engaging in IC testing. These companies laid the foundation for the semiconductor industry by establishing a prototype for the integration of all of the elements of Chinese Taipei's IC industry. In addition, the companies established strategic alliances with other countries, which led to the IC sector becoming the leading industry in the park. As a result of the stable development stage, which has been taking place since 1993, the IC industry has become the number one industry in the park in terms of the number of companies, people employed, capital investment, and sales revenue. At that time, the market began to pull money in, and the model of vertical disintegration was completed as this unique clustering effect helped Chinese Taipei's science-based technical industry to enter the global market. The vertical disintegration of the IC industry also became the norm in the development of Chinese Taipei's high-tech industry.

The development of the industrial park is closely related to the return of Chinese engineers from overseas. The increase in the number of overseas Chinese engineers returning to Chinese Taipei led not only to the technological development of the industrial park, but also to the rapid development of the economy as a whole.

Obtaining technologies from foreign economies has long been Chinese Taipei's major industrial development strategy. Many researchers have pointed out that to a very great extent, technology licensing, venture capital, and foreign investment have contributed to the development of the local industry. In addition, many studies have asserted that returning engineers from the U.S. (where they received their higher education) have made significant contributions to the development of Hsinchu (Castells and Hall, 1994;

Hobday, 1995; Mathews, 1997); however, these studies have largely assumed the U.S. (Silicon Valley) to be the major export source of core technologies, while Hsinchu is seen as merely a peripheral area of industrialization since it receives the importation of foreign technologies in a passive way.

Although these studies have explained why Chinese Taipei is no longer a low-wage manufacturing base, they have not articulated the ways in which the new dynamics emerging from the interaction between Hsinchu and Silicon Valley have affected technological development in Chinese Taipei. Indeed, such interaction is moving towards a complementary and mutually beneficial relationship rather than a hierarchical and zero-sum relationship. These studies have therefore ignored the phenomenon of interactions with multinational corporations (MNCs) in the construction of various global economic systems. For this reason, we will explain international interaction from a perspective of technology connection, and from an alternative perspective of the introduction of skilled manpower.

Technology connections

The most successful example of R&D clustering is indeed the technology cluster in Silicon Valley. The subsequent connections developed between Silicon Valley and the HSIP were built up by overseas engineers and specialists returning from Silicon Valley to Chinese Taipei, as these connections were based on personal networks via international strategic alliances wherein joint R&D is conducted between MNCs and Chinese Taipei's subcontractors. For example, Chinese Taipei Windows CE Alliance was an alliance that targeted at expanding the share of the software market. Such cooperation not only accelerated the development of high value-added products, but also reduced the obstacles to R&D through close ties with the major international firms. Such a scenario indicates that Chinese Taipei's high-tech firms are fairly aggressive in both their R&D and their competition for technology licenses, and it also indicates that Chinese Taipei's firms have developed a technological capacity that the international community has clearly recognized.

Introduction of skilled manpower

HSIP is supported by a strong research center in close proximity to the park. Two major universities, Tsing Hua and Chiao Tung, are located just outside the park, with both of these universities having traditionally placed significant emphasis on science and engineering disciplines. By 2003, the two universities had a combined student population of 20,268, along with 1,066 professors. Collaborative research projects are often conducted between universities and companies in the park; furthermore, the government-sponsored research institute, ITRI, is located only five kilometers away from the park. Employment within the park is naturally biased toward skilled workers. By 2003, the park was employing a total of 98,685 workers, of which 46% were junior college graduates or above.

Before Chinese Taipei's own capacity for R&D was fully developed, the aggressive recruitment of overseas engineers and specialists helped to bring in advanced technologies and know-how. The introduction of these talented employees contributed to the development of Chinese Taipei's semiconductor and information industries for a number of reasons. Firstly, overseas Chinese workers have an impressive track record of service. Chinese Taipei and the U.S. established a special and close relationship way back in the 1950s, with this relationship incorporating material supply during the early stage, and thereafter increasing the numbers of returning overseas students. This relationship provided Chinese Taipei with easy access to Western culture and language.

Secondly, Chinese Taipei developed itself into a depot for MNCs in the Asia-Pacific region by improving its relationships with Japan and Europe. It is affirmed that there was a considerable correlation between the development of Chinese Taipei's electronic and information industry, and talented individuals educated in the U.S. Chinese Taipei's government has offered strong incentives to encourage overseas specialists to return to work back home. By the year end of 2001, there were 4,292 overseas engineers and specialists working in companies in HSIP, and 123 companies established by Chinese entrepreneurs returning from abroad.

Entrepreneurship encouragement

Owing to international technology transfer and the nurturing of manufacturing ability, HSIP's favorable environment created a swarm for entrepreneurship in the mid-1990s. In this period, technology personnel from the IC, computer, and peripheral industries began to set up their own businesses. At the end of 2001, the start-up companies owned by overseas Chinese had reached 723. The key to this entrepreneurship has been threefold. First, the Industrial Technology Research Institute (ITRI) transfers its research results, which means a rise in the number or spin-off companies. As of the year 2000, ITRI officially has spun off 31 companies (Wang and Hsu et al, 2002). Second, the demonstration effect instigates entrepreneurship. Since the mid-1990s, Chinese Taipei's IC manufacturing companies (TSMC, UMC) and IC design houses have performed beyond expectation; consequently, this has encouraged more people to start up their own ventures and entrepreneurship has spread. Third, the boom of venture capital also contributes greatly to starting up businesses by raising funds in the early stage.

The future development of the HSIP

Chinese Taipei is currently facing a crossroad in its R&D and manufacturing. The decision on which role to stand by, between R&D and manufacturing, depends on how entrepreneurs in Chinese Taipei perceive their future. Since Chinese Taipei's high-tech clusters are under pressure to transform themselves, there will be a risk of them being substituted by competing clusters in Shanghai if the wrong decisions are made. Thus, leading enterprises in the industry must take this problem seriously and consider how to turn this challenge into an opportunity to achieve another period of growth in technology in Chinese Taipei. These enterprises should also follow the role model set by Silicon Valley and aim to improve their own level of competitiveness in technological development.

As regards to the outlook for the industry's comparative advantage, rather than expanding its manufacturing capacity, Chinese Taipei should work harder to develop R&D centers. It is also be necessary for Chinese Taipei to maintain its R&D in high value-added areas in order to create a complementary relationship with Shanghai for the sustainable development of its high-tech industry. Secondly, Chinese Taipei should cooperate with Silicon Valley to make up for the lack of necessary technology required for use in innovative R&D centers. This cooperation should also cover technology transfer and the establishment of cross-border R&D centers so as to make use of foreign technological resources in order to improve local technologies.

Chinese Taipei's high-tech companies have already transformed themselves from 'original equipment manufacturer' (OEM) subcontractors to 'original design manufacturers' (ODMs), and are now moving towards becoming 'original brand manufacturers' (OBMs). High-tech businesses on the island should endeavor to enhance the vertical disintegration of R&D and manufacturing, while also seeking to develop core industrial competitiveness through complementary and cooperative disintegration between Silicon Valley and Shanghai.

3.2 Silicon Valley, U.S.A.

Silicon Valley is geographically contained within a 30-mile by 10-mile strip of land between the cities of San Francisco and San Jose in in Northern California. This economic region begins in the northwest part of Silicon Valley in Palo Alto, where the bulk of theoretical and practical research in the technology field is carried out at Stanford University and Stanford University Research Park.

A combination of regional advantages and historical accidents have conspired to produce the greatest 'science park' in the world, and observers have identified a number of regional advantages for the valley, including world-class academic institutions (Stanford University and the University of California, Berkeley), brilliant scientists, military procurement of semiconductors, and the pleasant climate of Northern California (Rogers and Larson, 1984).

Several factors have been attributed to the success of the valley, the first of which is the influence of nearby higher education institutions, particularly Stanford University. In the 1920s, Stanford recruited highly-respected faculty members from the East Coast of the U.S., including such important recruits as Fred Terman, David Hewlett, and William Packard, who became the pioneers for innovation and commercialization of innovative products. In 1950, Hewlett-Packard (HP) sold 70 different products, achieving sales in excess of US$2 million and rapidly expanded to a 200-employee company. The formation of HP's distinctive Silicon Valley management style soon encouraged numerous enterprises to follow. In 1954, HP rented part of the Stanford Research Park for its operations, which then led to the formation of the cluster of industries in Palo Alto.

Secondly, the U.S. government also played a major role in the prosperity of Silicon Valley. The relocation to California of the military contractor Lockheed in the mid-1950s brought federal defense dollars to the area, while public procurement from defense agencies also hastened the growth of the semiconductor industry.

Thirdly, the flexible environment, informal means of information exchange, and the high level of labor mobility also promoted collective learning and flexible adjustment between companies that subsequently encouraged further entrepreneurship and experimentation (Saxenian, 1994).

Contributions of Silicon Valley to the U.S. economy

The driving force behind the economy in the valley is technology, and more specifically, specialized clusters of technology firms and talented individuals. Almost 40% of Silicon Valley's workforce is employed in technology-related industries, and many more jobs are tied to the support of these industries. These clusters are dynamic, constantly innovating and changing. They draw strength from the valley's business environment, its tangible assets, such as world-class universities, extensive supplier networks, and specialized professional services, as well as from intangible qualities such as competitive spirit and the willingness to take risks.

In the 1990s, Silicon Valley's economy shifted from a high-tech manufacturing economy to a knowledge-based economy. This economy is now moving towards higher value and greater service-oriented activities. The valley's competitive advantage comes from the productive and creative use of human inputs, from value rather than from volume.

After more than 50 years of continuing progress, Silicon Valley has made a significant contribution to the long-term economic development of the U.S., with a number of indices demonstrating its importance. First of all, the value added per employee in the valley (a measure of productivity), increased by 4.6% in 2001 to US$170,000, as compared to the national figure of US$56,000. Secondly, although the valley is home to less than 1% of the U.S. population, its latest annual patent awards came to more than 6,800, or 8% of all the patents awarded to U.S. residents.

3.3 Penang and the Kelang Valley, Malaysia

The industrial clusters in Penang and the Kelang Valley in Malaysia have enjoyed strong MNC operations in electronics manufacturing since the early 1970s. Indeed, foreign-owned corporations accounted for 83% of all fixed assets in the electronics industry in Malaysia in 1998. Comparing these two Malaysian electronics clusters and drawing on Rasiah (2002), this paper underlines the human capital and network cohesion that exists between the domestic and foreign firms within these clusters, and the coordination between government and businesses as the critical conditions for such industrial clustering.

Both regions enjoy advanced levels of basic infrastructure and educational institutions. Over the period from 1970 to 1990, high unemployment rates of around 6.0% to 8.1% ensured that MNCs engaged in labor-intensive assembly began relocating to this economy. Political stability, financial incentives, and controls on unionization ensured that Malaysia was one of the more attractive sites. However the exhaustion of labor reserves in the 1990s resulted in a significant shift in the demand structure for human capital in Malaysia's manufacturing sector. The resultant labor shortages, rising wages, and the emergence of other low production cost sites, such as mainland China, Thailand, and the Philippines, along with their improvements in basic infrastructure and political stability, began to challenge the ability of Penang and the Kelang Valley to sustain their operations.

The labor shortage problems of the 1990s led to a shift in the government's industrial strategies from a focus on employment generation to industrial deepening, clustering, and the upgrading of industry to higher value-added activities. These new policies included the ‘Action Plan for Industrial Technology Development’ in 1990 and the ‘Second Industrial Master Plan,’ which set out the guidelines for the proposed transformation in 1995.

Alongside the Federal Ministry of Education, which governs formal education institutions (including general, vocational, and technical education), the Human Resource Development Council Fund, which was established in 1993, required manufacturing firms with 20 or more employees to contribute 1% of their payroll to the council, which the firm could then reclaim by submitting bills from approved training establishments. In order to complement the domestic human resource capabilities, the government initiated exemptions for IT firms in the Multimedia Super Corridor (MSC) starting from 1997, to support the importation of technical and professional human capital from abroad.

Despite the intense emphasis on the development of infrastructure, the supply of high-tech human capital has consistently lagged behind the growing demand, and as a result there has been a severe widening of the gap between the supply and demand of human capital, and a constant structural mismatch caused by coordination problems within the two clusters. Both Penang and the Kelang Valley have therefore failed to establish a sufficient supply of high-tech human capital, largely as a result of the problems of poor coordination of supply and demand. Although allowing the immigration of professionals possessing high-tech human capital may be the only answer to overcoming this growing deficit, the main barriers to accessing such high-tech talent are the existing conservative immigration policies.

Penang

Penang’s manufacturing sector accounted for 13% of the economy’s GDP in 1971, a figure that subsequently rose to 46% by 2000. The electronics industry in Penang employed over 90,000 workers in 1995, with the outstanding economic performance of this particular cluster being attributed to the important contribution of the MNCs. The essential intermediary role of the Penang Development Corporation (PDC) was established in 1969 with the aim of placing considerable effort into attracting export-oriented MNCs into the manufacturing sector. Integrated business networks, with the PDC fuelling their cohesion, have helped in the dissemination of knowledge embodied in human capital for the creation of new firms, differentiation, and the division of labor. The development of the MNCs has driven strong supplier networks, while institutional coordination aimed at supporting their growth has increased the localization of inputs by MNCs.

From a perspective of a global production network, Penang has successfully drawn industry ‘species’ from other locations. Specific capabilities, in terms of specialization, have helped the region to sustain its level of growth and have provided the mechanisms for accelerating inter-firm links. Industry ‘sub-species’ have also evolved domestically in Penang to stimulate further differentiation and diversity. The development of several tiers of firms has enabled workforces to further expand their development of knowledge and its dissemination within the Penang cluster. Within such clusters, there is often a number of MNCs that tend to play the vital role of a training ground for the hiring and nurturing of entrepreneurs. This has thus stepped up the creation of new firms and has led to a more flexible industrial system within the region. In contrast to the Kelang Valley, Penang has been able to develop sufficient network cohesion and institutional coordination to support the need for flexibility and interface between its domestic firms and the MNCs. Strong inter-firm relations and systemic coordination effects have thereby generated and expanded this industrial clustering while also appropriating considerable economic synergies.

Kelang Valley

Barely trailing the accomplishments in Penang, the electronics industry in the Kelang Valley was employing almost 85,000 people in 1995, and in fact the Kelang Valley was better endowed than Penang when the first major influx of electronics MNCs relocated to Malaysia in the early 1970s. As a result, it was quickly able to set up its high-volume production capacities in consumer electronics, semiconductors, and picture tubes. However, the lack of an intermediate agency, such as the PDC in Penang, weakened the network and inter-firm cohesion in this cluster, despite the fact that it already enjoyed a concentration of manufacturing firms. This resulted in the development of comparatively less knowledge spillover and the lack of a real stimulation of inter-firm links and new firm creation.

Generally speaking, many of the parts and components produced by industries within this cluster, particularly those for the electronics industry, have been produced as elements within global production networks coordinated by the parent MNCs. A number of high value-added components, such as TFT-LCD display screens, are imported from their subsidiaries or suppliers located in their home bases. Parts of the foreign MNCs act as anchors, offering markets and technological support for both foreign and local firms. However, most local suppliers are still limited to low value-added non-core activities, and hence the key technologies and high value-added components are mainly imported from MNCs' other expatriate subsidiaries, or from their home countries, such as the U.S., Japan, and Chinese Taipei.

As a result of their poor network cohesion with domestic firms, MNCs in the Kelang Valley not only have to source from abroad, but also must internalize the production of their upstream activities, demonstrating that the more popular form of division of labor is intra-firm rather than inter-firm. The competitiveness of local firms is largely undermined by their costly and poor quality supplies, which results in MNCs building up very few industrial linkages within the domestic economy. Indeed, foreign firms will generally tend to source most of their supplies from their home bases. We therefore expect that the weakness of the vertical division of labor between MNCs and local suppliers in the Kelang Valley has also led to limited knowledge spillover.

In addition to infrastructure and national policies, human capital (in particular, abundant skilled labor and entrepreneurship, which are the international linkages that are embodied in MNCs) has become even more important in driving the formation of industrial clusters, especially in this era of globalization of production. Some successful industrial clusters have managed to overcome the problem of local supply capabilities falling behind the existing demand by absorbing those foreigners who have working permits.

In the past, when the immigration of foreign professional workers was restricted, Penang relied on the network cohesion derived by the PDC, the intermediate agency, to improve systemic coordination, and the relative ease of firm entry and exit encouraged entrepreneurship. The presence of such systematic coordination also helped to develop the inter-firm dissemination of tacit and experiential knowledge in Penang, much more so than in the Kelang Valley. As noted by Rasiah (2001), the quality of government vis-à-vis business coordination in Penang means that even small machine tool firms in Penang perform much better than those in the Kelang Valley. Today, the restrictions on the movement of professionals have been largely relaxed, and both Penang and Kelang Valley have seen new vitality in their respective high-tech industries.

From an examination of the experiences of Malaysia's cluster development, there is clearly an imbalance in the demand and supply of research students, scientific researchers, and engineers. However, it is also unlikely that industry would be able to increase the inflow of scientific talent from overseas, largely because of the economy's very restrictive immigration policies. Inadequate scientific manpower makes it impossible for Malaysia to attract large numbers of high-tech companies to move into Penang and the Kelang Valley, but the tacit and experiential knowledge attached to human resources in Penang still differs from that in the Kelang Valley.

The Penang Development Corporation (PDC) created the Penang Skills Development Centre (PSDC) as a means of helping vendors to solve their personnel and training problems. The open networks between the companies also have reinforced the available interface for adjusting demand and supply in the production lines. These networks then turned some companies' technological limits into other companies' business opportunities, which in turn, strengthened the differentiation and professional labor disintegration in the production system, bringing in human resources with experience and knowledge. This also succeeded in improving the dynamics and diversification of industries in Penang.

In contrast to the industrial development in Penang, there is a lack of connections and networks between the cross-national electronic companies in the Kelang Valley, although these companies are characterized by world-class production and operation methods. The other disadvantage is that the supporting authorities in the local government did not fulfill the role of a communicator between the companies. Clearly, the industrial operations in the Kelang Valley lack differentiation and well-defined labor distribution.

3.4 Hamamatsu, Japan

Hamamatsu, comprised of a cluster of machinery and musical instrument industries, is located to the south of Tokyo, with famous companies within the cluster including Honda, Suzuki, Yamaha, and Kawai. The most notable feature of Hamamatsu has been the smooth transition of its traditional industries to modern practices. Once a center for the production of textile machinery (prior to the World War II), Hamamatsu successfully transformed itself into a post-war manufacturing center for motorcycles and musical instruments. Today, it is still one of the most important manufacturing centers in Japan for machine tools and musical instruments.

As a home base for Suzuki Motor, which has evolved from a producer of motorcycles into an automobile manufacturer, Hamamatsu provides virtually all the parts needed for auto manufacturing. Suzuki's major parts suppliers are located within a 15-km radius of its Hamamatsu plant, thus allowing face-to-face communications at all times. Such proximity and close contact with suppliers reduces transaction costs and facilitates the effective coordination of production. Supporting these parts, suppliers make up a network of companies specializing in metal molding, precision instruments, computer-aided design, computer software, and so on. This supporting industry underscores the strength of the Hamamatsu cluster.

Hamamatsu also boasts a large number of angel and venture capitalists (VCs). Indeed, there is no shortage of investors for those who can manage to come up with a novel product. Many experienced entrepreneurs have turned themselves into VC managers, providing advice to young entrepreneurs seeking to start up their own companies. It is estimated that Hamamatsu is the most concentrated area of VC companies in Japan (Takeuchi, 2002:37) and these VCs are well connected to local financial institutions which provide them with the necessary refinancing, while local financial institutions are also accustomed to collaborating with such VC operations.

The development of Hamamatsu into an industrial cluster has a long history. Hamamatsu has been an important manufacturing center ever since Japan first started out on its path towards industrialization in the 19th century. From its inception as a manufacturing center, the area has been characterized by stiff competition within the same industry. Product variety is the key feature of this competition, with less efficient companies being eliminated and thus allowing the small number of surviving firms to dominate the regional market, the Japanese market, and even the global market. In the heyday of the motorcycle industry, for example, which only emerged after World War II, there were at least 30 brands competing with one another. In the end, only Suzuki, Honda, and Yamaha survived, and even today these are still the three major motorcycle producers in Japan, which also dominate the motorcycle market on a global scale. The only major Japanese motorcycle producer outside of Hamamatsu city is Kawasaki, which is located to the north of Hamamatsu.

In the case of musical instruments, the rivalry between Yamaha and Kawai is also notable, with both aspiring to become the world's leading brand. Competition drives innovation and forces competitors to mobilize their upstream suppliers and downstream service providers to engage in closer collaboration. Collaboration takes place not only in the area of production, but also in the area of R&D, with the co-design of products allowing collaborators to exchange information and to share knowledge.

Rivalry exists not only within the market, but it is in fact also noticeable within the community. The employees of the large companies stride along the middle of the street, while those of small companies tend to walk along the side of the road. Rivalry between schoolmates and neighbors also extends to the competition between companies, with such a rivalry having inspired new innovations and the start up of new enterprises.

Hamamatsu is renowned for its ability to continuously produce new industries to replace older ones. As already noted, motorcycle manufacturers such as Honda and

Suzuki have successfully transformed themselves into auto manufacturers, while musical instrument makers, Yamaha and Kawai, have evolved from the production of organs and pianos to manufacturers of electronic musical devices. Furthermore, the more traditional machinery industry has been on a decline in recent years, but the photo electronics industry has emerged as a new industrial force to replace it.

Within this section, the sustainability of a cluster has been the most important policy issue to be explored. Such sustainability implies that naturally-endowed factors are not the key element for a successful cluster, because the region's comparative advantage will shift over time and the price of naturally-endowed factors will usually be bid up by the growth of the industry. Indeed, if naturally-endowed factors are to be the key to competitiveness, the success of the cluster would become its own enemy. Therefore, comparative advantage must be created through assets such as skilled labor or institutions that are capable of keeping the cluster going. Companies in Hamamatsu are noted for their ability to jump industries. For example, between 1991 and 1994, 1.1% of enterprises in the region switched from one industry to another, the highest proportion amongst all major industrial cities in Japan (Takeuchi, 2002:34). Many manufacturers of musical instruments diversified into electronics machinery, with such industrial switching being considered a second round of a start-up of a new business by existing companies.

The core strength underpinning the evolution of industry in Hamamatsu is its embedded manufacturing capability, a capability that is particularly evident in the vehicle manufacturing industry. From motorcycles to automobiles, Japan's major manufacturers were all born in Hamamatsu, with the subcontracting system comprising of parts suppliers, assemblers of semi-finished goods, and machine tool providers, forming a strong network jointly responsible for complete vehicle production The vehicle industry is underpinned by a strong and comprehensive machinery industry which was in turn initially cultivated by the textiles industry. The machinery industry is itself also underpinned by a strong casting and precision measurement industry.

The experience of Hamamatsu points conclusively to the key roles played by specialized suppliers, while the presence of an effective venture capital community, which was conducive to business start-ups, also helped with the transformation of industry. It is also very noticeable that the companies in the Hamamatsu cluster are globally connected, with their products being strongly oriented towards the international market.

3.5 Summary

There are several identified advantages derived by an industrial cluster. First of all, the experiences of selected industrial clusters witness that industrial clusters can provide complementary resources such as technology and information exchange, management assistance, and so on, in order to enhance the performance of firms, especially SMEs, within the cluster.

Secondly, as especially shown in Hamamatsu's case, industrial cluster strengthens competition and thus promotes the technical efficiency of firms. Since these firms are located in a very close proximity, fierce competition for both clients and suppliers is unavoidable. However, competition also pushes up efficiency.

Thirdly, firms can quickly respond to the demands of the market or to changes in technology. Firms within the cluster can reorganize their OEM contractors much more quickly than those outside of the cluster. Thus, the ability to leverage resources to adapt to the market and to fluctuations in technology has been a major benefit for firms locating within the cluster.

Finally, industrial clustering and networking can be of great importance to SMEs. Clusters offer SMEs positive externalities. Co-operation between agents within clusters and networks, through the sharing of information, resources, knowledge and technical expertise, and other forms of joint action reduce transaction costs and further enhance competitiveness as well as accelerate learning and technical innovation.

4. Possible Issues for Discussion by the Symposium

In terms of sustaining SMEs' innovation capability in the global competition, there are some critical issues raised that are related to the industrial cluster-based policies as follows.

4.1 Conditions for the Formation of a Successful Industrial Cluster

The role of factor endowment in the formation of an industrial cluster has changed. Traditional literature along the line of Marshall (1890) has assumed factors to be immobile across countries, but globalization has allowed many factors to be mobile across national boundaries, particularly capital and skilled labor. It is nowadays common for someone to be born in one economy, educated in another economy, and to work in yet another economy. Human skills also tend to cluster. Most financial experts work in London and New York, most IC-related engineers work in Silicon Valley. These experts and engineers may be born anywhere in the world. The right environment and institutions can attract the flow of skills. In the past, advanced countries attracted skills from developing countries, constituting a brain drain. Today, there is a reversal of that brain drain whereby skills flow from advanced to developing countries. If skills can indeed be obtained from the outside, then the three ingredients for the formation of a cluster would be reduced to only two: entrepreneurship and market access.

What is the role of government in the formation and development of clusters? Is skill training proactive or accommodative? Does this not mean that the government has not been "proactive" enough in identifying the missing part of the formula and finding a solution before a cluster-based policy is launched?

4.2 Interactions of Industries, Academics, and Research Institutes in an Industrial Cluster

It is also important to note the role played by universities or other research institutions (Santoro and Chaknabarti, 2002) in an industrial cluster. Universities may be a critical factor for the growth of a cluster. It is clear that a cluster will not grow without innovations, and innovations have to come from research.

It takes some high-caliber universities and research institutions to build the capacity to acquire and use the knowledge that has been produced. Firms that locate close to research centers benefit disproportionately from the knowledge produced in such centers, which is especially true for advanced research in fields such as biotechnology (Cooke, 2002 & 2003). Likewise, firms located close to other innovative firms are more productive in R&D output than those located far away (Wallsten, 2001; Orlando, 2000). Universities are also critical in providing high-skilled labor to support the growth of a cluster. More than that, close linkages between universities and industries are conducive to innovations and to the commercialization of new ideas.

Regional or national innovation systems have therefore been the focus of recent studies on cluster-based industrial policy (Lawson, 1997; Lundvall, 1998). The key elements of regional innovation systems are a group of networked institutions for the creation, combination, distribution, and application of knowledge. Again, innovation institutions are part of the group of institutions that underscore a cluster. The variety of clusters gives rise to a variety of national (regional) innovation systems, characterized with laws, regulations, and conventions for securities, taxes, accounting, corporate governance, bankruptcy, immigration, research and development, university—business links, intellectual property protection, etc. This system is most favorable to new business ventures (Rowen and Toyoda, 2002).

It is clear that the promotion of a regional innovation system should be the part of core cluster-based policies. Are there any barriers that remain in the way of spin-offs from universities or research institutes? Are there any important conditions, such as venture capital, for universities and research institutes to drive innovative clusters?

4.3 Liberal Trade and Investment Environment for Promoting Clusters' International Linkage

It has been witnessed that rapid cross-border dispersion is also a feature of industrial clusters, with the cluster-based economy and the future path of cluster development continuing to be of significant importance (Ernst, 2003). The need for systems integration has emerged, particularly in the ability to combine local connections with geographical differences. A significant example of this kind of evolution is the global production network (GPN), an important inspiration for the future development of industrial clusters. International connections are thus essential with regard to the sustained growth of industrial clusters and SMEs. In terms of upgrading SMEs' innovative capability, GPN extends the value chain of a company and fosters greater business opportunities for professional suppliers that are small and medium sized. As suppliers continue to upgrade their capacity, this places additional pressure upon the clusters, in terms of the need for the continuous introduction of knowledge-intensive and high value-added supporting activities. Thirdly, the participation of small and medium-sized enterprises (SMEs) in the GPN helps them to obtain knowledge and to overcome the obstacles traditionally involved in this process.

Trade liberalization programs and the increasing globalization of markets have been a key motivator in pushing small firms towards a more demand responsive approach. Without a doubt, a liberal trade and investment environment should be critical for facilitating GPN and industrial clusters. However, the raised issues are as follows: What are the main difficulties for SMEs joining the GPN? How do the institutional settings help SMEs to benefit from GPN? Should multinationals play a role in facilitating a regional innovation system in a developing country? The session exchanges viewpoints or experiences in how to effectively promote GPN for SMEs through industrial clusters.

4.4 E-commerce and Industrial Clusters

The role of e-commerce in driving the global economy is widely recognized. The new information technologies reach many firms and people, have wide geographical coverage, and are efficient in terms of time and cost. They facilitate access to markets, commercial information, and new processing technologies and knowledge. Some, however, are concerned about whether small firms have equal capabilities to access these new information technologies and the Internet. What are some promising new opportunities for SMEs? What are the main barriers SMEs have to overcome to participate actively in the digital economy? These questions are increasingly being addressed by policy-makers in both developed and developing countries, as well as by the international community in general. The session examines strategies and mechanisms for effective cross-border SME e-commerce in the region. The goal is to exchange ideas in how to effectively promote strategic alliances among SMEs through industrial clusters and E-commerce in the area of supply chain management and how strategic alliances benefit member economies along the supply chain.

4.5 How SMEs Benefit from Industrial Clusters

The Literature has identified clustering as an important element of small firms' production organization. In many cases it has been observed that clustering provides small producers with grounds for competitiveness that goes beyond the traditional advantage of cheap labor. Inter-firm relations that are set in motion through clustering and networking often alleviate constraints that SMEs have traditionally faced. Small enterprises are able to gain access to inputs, make connections with buyers, and overcome technological discontinuities. Alongside these externality gains of clustering, the constant flow of technical know-how and marketing intelligence as well as intense local rivalries have spurred attempts to technically innovate and enhance competitiveness. Such tendencies are further strengthened through various forms of joint actions and through the intervention of local technical institutions providing "real" producer services.

Industrial clusters and industrial networks surely offer a potential for SMEs to upgrade their products and processes and compete in global markets. The discussed issues posed in the section are: How does co-operation take place between firms and other agents such as input suppliers, specialist subcontractors, service providers, and buyers within an industrial cluster? How is technical learning and innovation enhanced? What roles do trade associations and common service centers, public sector institutions, and government policy play in facilitating the development of innovative clusters and networks of SMEs?

Moreover, as trade liberalization and keen global competition force the pace of industrial development for SMEs, it now becomes important that enhanced flexibility, increased responsiveness, and upgraded quality standards are of growing importance in maintaining competitiveness. Investing in supply networks and upgrading small suppliers such that they can meet the quality requirements and tight delivery schedules of large producers is quite essential. How to help SMEs to incorporate large international flagship firms' quality requirements should also be an important achievable goal.

REFERENCES

Audretsch D. B. (2003), "Entrepreneurship Policy and the Strategic Management of Places." D. M. Hart, (eds.), *The Emergence of Entrepreneurship Policy*, Cambridge University Press, 20-38.

Audretsch, D.B. and M. Feldman (1996), "R&D Spillovers and the Geography of Innovation and Production," *American Economic Review*, **86**, 630-640.

Baptista, R. and P. Swann (1998), "Do Firms in Clusters Innovate More," *Research Policy*, **27**(6): 525-40.

Baptista, R. and P. Swann (1999), "The Dynamics of Firm Growth and Entry in Industrial Cluster: A Comparison of the US and UK Computer Industries." *Journal of Evolutionary Economics*, **9**:373-399

Barkham, R., Gudgin, G, Hart, M. and Hanvey, E. (1996), *The Determinants of Small Firm Growth: An Inter-Regional Study in the United Kingdom 1986-90*, London, UK.

Castells, Manuel and Peter Hall, (1994), *Technopoles of the World: The Making of Twenty-First-Century Industrial Complexes*, London: Routledge.

Cooke, P. (2002), "Biotechnology Clusters as Regional, Sectoral Innovation Systems," *International Regional Science Review*, **25**(1), 8-37.

Cooke, P. (2003), "Biotechnology Clusters; Big Pharma' and the Knowledge-Driven Economy," *International Journal of Technology Management*, **25**(1/2), 65-80.

Dahlman, C. J. (1979), "The Problem of Externality," *Journal of Law and Economics*, **22**, 14-162.

David J. Storey (1994), Understanding the Small Business Sector. Chapman & Hall.

Dumais, G., G. Ellison, and E. Glaeser (1997), "Geographic Concentration as a Dynamic Process," *NBER working paper* #6270.

Ernst, D. (2003), "Global Production Networks and Upgrading Prospects in Asia's Electronics Industries," Mimeo, Hawaii, East West Center.

Gemser, G, and N. M. Wijnberg, (1995), "Horizontal networks, appropriability conditions and industry life cycles," *Journal of Industry Studies*, **2**:129-140.

Glaeser E., H. Kallal, J. Scheinkman, and A. Shleifer (1992), "Growth in Cities," *Journal of Political Economy*, **100**: 1126-52.

Hobday, M. (1995), "Innovation-Innovation in Services," *SI4S Synthesis Paper. Oslo: STEP Group*.

Hoogstra, G. J. and J. V. Dijk (2004), "Explaining Firm Employment Growth: Does Location Matter?" *Small Business Economics*, **22**: 179-92

Jovanovic, B. and R. Rafael (1989), "The Growth and Diffusion of Knowledge," *Review of Economic Studies*, **56**(4): 569-82

Lawson, C. (1997), "Territorial Clustering and High-Technology Innovation: From Industrial Districts to Innovative Milieux," *Working Paper* 54, ESRC Center for Business Research, University of Cambridge, UK.

Lechner, C. and M. Dowling (2000), "The Evolution of Industrial Districts and Regional Networks: the Case of the Biotechnology Region Munich/Martinsried," *Journal of Management and Governance* (Special Issue), **99**(3): 309-38.

Lechner, C. and M. Dowling (2003), "Firm Networks: External Relationships as Sources for the Growth and Competitiveness of Entrepreneurial Firms," *Entrepreneurship & Regional Development*, **15**: 1-26.

Lundvall, B. A., (1998), "Innovation as an Interactive Process: From User-Producer Interaction to the National Systems of Innovation," in G. Dosi (ed.) *Technological Change and Economic Theory*, London: Printer Publisher.

Mai, C-C. and S-K. Peng, 1999, "Cooperation vs. Competition in a Spatial Model," *Regional Science and Urban Economics*, **29**: 463-472.

Mai, C-C., (1996), "Agglomeration Economies and Spatial Competition: Comments on the Establishment of Hsin-Chu Science-based Industrial Park", paper presented at the

Conference in Memory of Liu Ta-Chung, Taipei: Liu Ta-Chung Educational and Cultural Foundation (in Chinese).
Marshall, A. (1890), *Principles of Economics,* London: Macmillan (for the Royal Economic Society).
Maskell, P. (2001), "Towards a Knowledge-based Theory of the Geographical Cluster," *Industrial and Corporate Change,* **10**(4): 921-943.
Mathews J. (1997), "A Silicon Valley of the East: Creating Taiwan's Semiconductor Industry," *California Management Review*, **39**(4): 26-54.
Orlando, M. (2000), "On the Importance of Geographic and Technological Proximity for R&D Spillovers: An Empirical Investigation," *Federal Reserve Bank of Kansas City, Research Division, working paper*.
Porter, M. (1998), "Clusters and the New Economics of Competition," *Harvard Business Review*, Nov.-Dec., 77-90.
Rasiah, R. (2002), "Systemic Coordination and Human Capital Development: Knowledge Flows in Malaysia's MNC-Driven Electronics Clusters," INTEC Discussion Paper Series, #2002-7, The United Nations University.
Rogers, E. M. and J. K. Larsen (1984), "Silicon Valley Fever," *NY: Basic Books.*
Rosenthal, S. and W. Strange (2001), "The Determinants of Agglomeration," *Journal of Urban Economics*, **50:**191-229.
Rowen, H. and M. Toyoda (2002), "Japan Has Few High-Tech Startups: Does It Matter? Can It Be Changed?" Working paper, Hoover Institution, Stanford University.
Santoro, M. and A. Chaknabarti (2002), "Firm Size and Technology Centrality in Industry – University Interactions," *Research Policy*, **31**(7), 1163-80.
Saxenian, A. (1994), "Regional Advantage: Culture and Competition in Silicon Valley and Route 128, Cambridge, Massachusetts, and London," England: Harvard University Press.
Solvell, O. and I. Zander (1998), "International Diffusion of Knowledge: Isolating Mechanisms and the Role of the MNE," in Chandler, A. Jr., P. Hagstrom and O. Solvell (eds.), The Dynamic Firm: The Role of Technology, Strategy, Organization and Regions, Oxford and New York: Oxford University Press, pp.402-16.
Storey, D. J., (1994), Understanding the Small Business Sector, London: Routledge.
Takeuchi, H. (2002), "Hamamatsu Kigyo Tsuyosa no Himitsu (The Secret Strength of Hamamatsu Enterprises)," Tokyo: Toyo Keizai Shinpo Sha.
Wallsten, S. (2001), "An Empirical Test of Geographic Knowledge Spillovers Using Geographic Information Systems and Firm-level Data," *Regional Science and Urban Economics*, **31**:571-599.
Wang K. and C.-W. Hsu et al., (2002), "The Post, Present and Future of Hsin-Chu Technological Cluster," Mimeo.

Remarks by

Ambassador Choi Seok Young
Executive Director
of the APEC Secretariat

at

the APEC Symposium on
Industrial Clustering for SMEs

8-9 March 2005

Taipei, Chinese Taipei

Deputy Minister Steve Chen,
Distinguished delegates,
Ladies and gentlemen,

Let me begin by expressing my heartfelt appreciation to Mr. John Chen, the APEC Senior Official of Chinese Taipei, who kindly invited me to this important event. It is indeed my privilege to speak on behalf of the APEC Secretariat at the APEC Symposium on Industrial Clustering for SMEs and Micro-enterprises.

I would also like to thank Chinese Taipei for its active role in developing a sound environment for SMEs and micro-enterprises in the APEC region. In the last two years, Chinese Taipei has organized two APEC Incubator Forums, an APEC Symposium on Best Practices for Financing Chains and a survey on industrial clustering.

SMEs are crucial to the economic growth and development particularly in the Asia-Pacific. It is not surprising that SMEs and Micro-enterprises represent more than 95% of all enterprises, produce around 50% of the GDP, and contribute an estimated 30% to exports in the APEC region.

In 2004, the SME Ministers gathered in Santiago, Chile, recognized that SMEs are key generators of innovation, wealth and employment among APEC economies. Ministers stated that the future of dynamic knowledge-based SMEs is core to the future of APEC. At the Santiago meeting, Ministers adopted the "Santiago Agenda on Entrepreneurship", which recognized two significant factors that allow SMEs to flourish.

The first of these is the development of an enabling business environment that encourages the formation and growth of enterprises. Ministers described such an environment as being characterized by stable macro and microeconomic policies that are business-friendly and legal and good governance systems. Ministers called for this environment to maintain a regulatory framework that facilitates sustainable business growth, and a culture that supports and rewards entrepreneurial endeavors.

The second factor recognized by the Santiago Agenda was that governments should assist in realizing the potential of the SMEs in their economies. The Agenda calls for governments to provide support for SME growth and remove barriers that impede their growth.

Ladies and gentlemen,

The success of the SME Ministers Meeting in Chile last year gave us a strong foundation to build on this year. Outcomes from the meetings of the Micro-enterprise Sub Group and the SME Working Group here in Chinese Taipei will contribute to ensuring the success of the current APEC year hosted by Korea. With the SME Ministers Meeting scheduled for August in Daegu, Korea, and the Leaders Meeting set for November in Busan, a series of APEC events of the year are certainly under way.

Today I would like to fill you in on some of the latest APEC developments that are also making a contribution to the success of the 2005 APEC Year.

The APEC process is unique in many ways. Since its inception in 1989, APEC has grown to become one of the world's most important regional groupings to promote trade and investment as well as building the regional community. Our membership of 21 Member Economies are home to around 2.6 billion people who in turn account for around 50 per cent of the world's GDP and more than 47 per cent of global trade.

APEC has traditionally focused on facilitating trade, investment and sustainable growth in the Asia-Pacific region. In working together to reach our goals, interaction in the APEC process is based on mutual respect, cooperation and consensus building. Changes in global economy and the new pressures being brought upon the region have seen the APEC agenda expanded in recent years. APEC action to deal with the ongoing threat posed by terrorism, cross-border health issues such as SARS and avian influenza, and natural disasters have reinforced the link between economic health and human security.

The APEC process is constantly evolving and each year progresses the achievements of the previous years. Last year, working to the theme of "One Community, Our Future," APEC Leaders and Ministers dealt with a number of issues which had significant regional and global repercussions. These issues included providing political leadership to progress the Doha Development Agenda of WTO negotiations and efforts to clarify the role of free trade agreements and regional trade agreements (FTAs/RTAs) in the APEC process. APEC Leaders and Ministers also sought to establish guidelines on the control of shoulder launched surface to air missiles (MANPADs) and collaborate on the implementation of the International Maritime Organization's International Ship and Port Facility Security, or ISPS, Code.

Progressing the APEC agenda into 2005, Korea has adopted the theme of "Towards One Community: Meet the Challenge and Make the Change." This is a bold statement on readiness in the APEC Region to tackle the challenges we face and take corrective measures if necessary. Korea believes that this theme clearly presents the strenuous will of APEC Member Economies to realize APEC's core goals in the area of trade and investment liberalization and capacity building.

In guiding the APEC process through 2005, Korea has identified seven priority areas. I will highlight some of these.

In the coming year, APEC will continue to work for the advancement of WTO DDA negotiations by contributing to the successful preparation of MC-6 slated for December this year in Hong Kong. This year, APEC will place a great deal of energy in strengthening anti-corruption efforts by establishing an Anti-Corruption Task Force. APEC is also turning its attention to taking stock of APEC's progress made thus far and its future direction by undertaking a midterm stock-take and developing a new roadmap for APEC's future activities.

The issue of human security is also expected to remain a top priority for 2005. Together with efforts to strengthen APEC counter-terrorism activities, energy security, health issues and natural disasters will also be key elements of the human security agenda. At SOM I, Senior Officials agreed to establish the Virtual Task Force for Emergency Preparedness. The new task force will seek to unify resources and skills in the APEC community to deal with future emergencies and natural disasters.

In 2005, APEC is also expected to take additional steps to foster innovation in science and technology by increasing knowledge about protecting intellectual property rights and enhancing digital opportunity.

Coming back to our area of work at this meeting, APEC 2005 will pursue its ongoing agenda in support of SMEs and Micro Enterprises. This will have special emphasis on nurturing businesses that have developed innovative and creative technologies.

The 2005 SME Ministerial Theme of "Promoting Innovation of SMEs" is quite timely during this current APEC Year when the call is being made for the region to "meet the challenge and make the change." This SME Ministerial theme recognizes that innovation is a practical response to the fast-changing international business environment and that SMEs must meet the challenge of innovation and evolve with this change.

Human resource development, technology and capital are the three key factors for encouraging innovation for SMEs. However SMEs cannot expect to meet the challenges of new technologies and opportunities on their own.

Strengthening linkages between SMEs and the research community as well as with businesses in other industries and other economies is essential. Networking and clustering within and across borders builds synergies between numerous stakeholders in the regional economy and delivers tangible benefits to SMEs that is active in this process.

Today the APEC Symposium on Industrial Clustering for SMEs will advance prospects for fostering industrial clusters in APEC economies. This symposium will also seek to determine the best way to strengthen the regional trade and investment environment for building regional industrial clusters. In all of these efforts, it is also heartening to know that the unique needs and characteristics of SMEs and micro-enterprises are also being taken into consideration.

I am confident that the outcomes of this symposium, along with the SME Working Group and the Micro-Enterprises Sub Group Meetings will lay firm groundwork for the upcoming SME Ministerial Meeting in Korea and deliver substantial benefits for SME's around the APEC region.

Thank You.

MOEA

Creating a Favorable Environment for SMEs Industrial Clustering

Deputy Minister Steve Ruey-Long CHEN
Ministry of Economic Affairs, Chinese Taipei
March 8, 2005
APEC Symposium on Industrial Clustering for SMEs

1

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Importance of Industrial Clusters

- Industrial clusters have been recognized as an important mechanism for SME development.
- Through clusters, SMEs are able to quickly obtain knowledge about marketing, technology and business operations.
- Industrial clusters reduce SMEs' transaction costs and increase competition and production efficiency.
- Innovations can be stimulated through resource and information sharing and frequent personnel interactions in clusters.
- The purpose of this symposium is to formulate best practice guidelines on industrial clustering for APEC economies.

2

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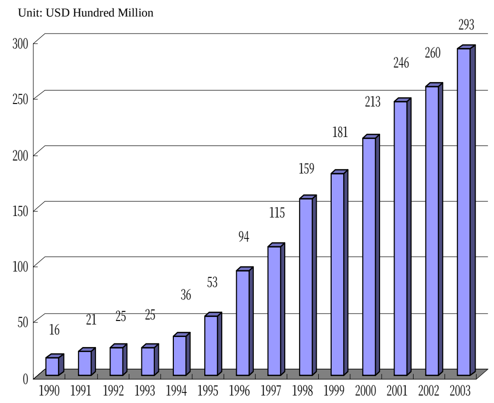
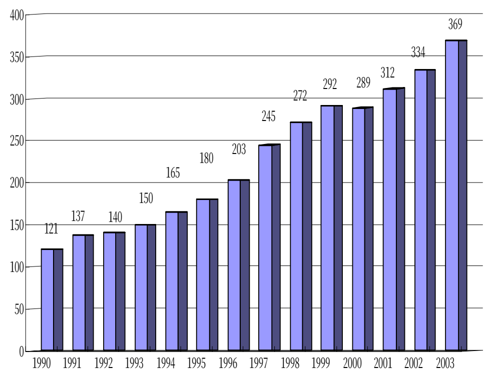
Current Status of Industrial Clusters

Hsinchu Science Park



Paid-in Capital



Number of Firms

3

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Current Status of Industrial Clusters

Hsinchu Science Park

Success of the Hsinchu Science Park

- **Close relationship with each other in production, sale and R&D**
- **Two major universities and ITRI located near to the park.**
- **Close linkage with foreign ICT technological centers**
- **Government Assistance**

4

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Current Status of industrial clusters

The Science Park on the Southern Area of the Island

- Established in 1997, it has attracted 127 companies with total approved investment around USD 40 billion.
- Most firms are involved in the LCD business, forming a complete cluster in this sector.

The Science Park on the Center of the Island

- This park has started to accept application.
- It is designed as a nano-technology cluster, and aims to attract companies from various industries with the similar application of nano-technology.

5

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Current Status of Industrial Clusters

Clusters in Traditional Industries

- In Chinese Taipei, the machinery, textile, petrochemical industries have long benefited from industrial clusters. The machinery cluster in the center of the island is a typical case.
- The machinery industry requires a large number of parts and components suppliers, so the machinery cluster is constituted by numerous SMEs.
- The close connections between cluster firms make it possible to quickly obtain all necessary parts and components from a variety of firms.

6

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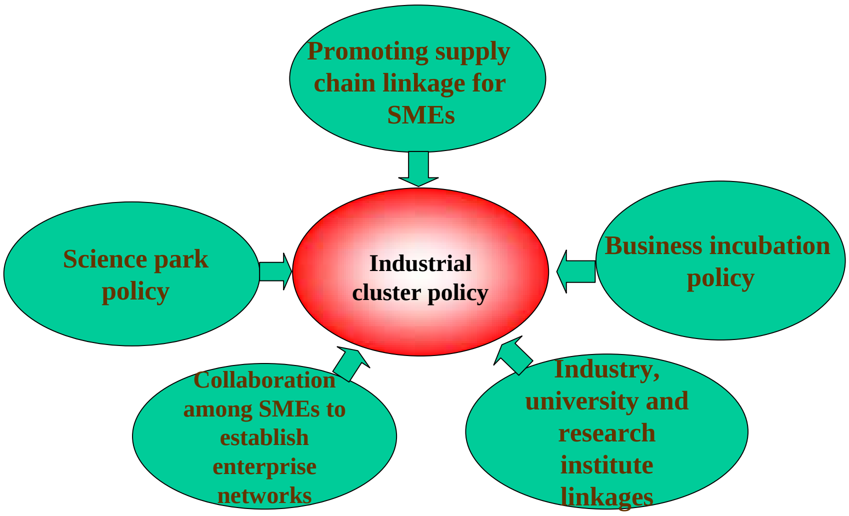
Policies for Promoting the Development of Industrial Clusters



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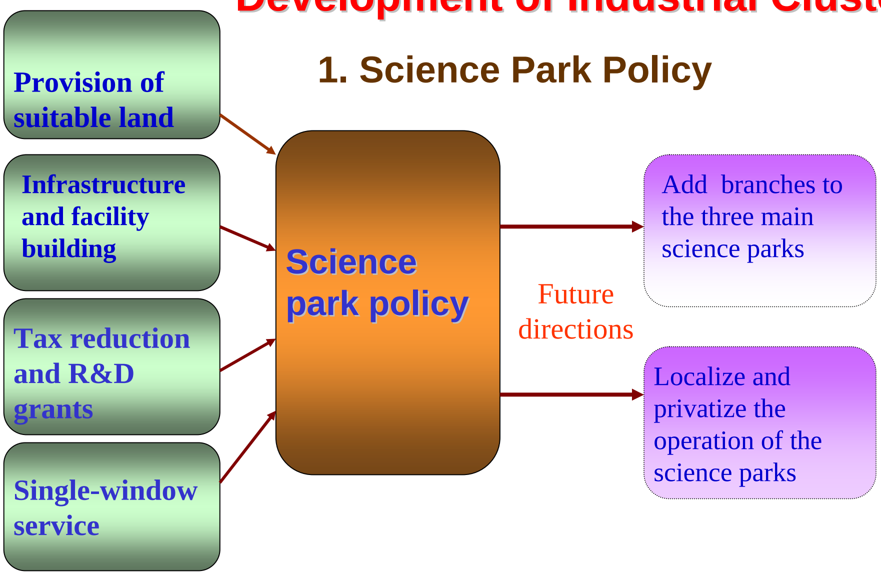
Policies for Promoting the Development of Industrial Clusters

1. Science Park Policy



8

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Policies for Promoting the Development of Industrial Clusters

2. Industry, University and Research Institute Linkages

- The Industry-University Cooperation Center provides firms with opportunities to conduct jointly research with university and offers technology consultation service.
- The Technology Transfer Center is in charge of transferring research achievements of universities to industries.
- ITRI functions as an R&D coordinator by grouping firms to jointly develop new technology.

9

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Policies for Promoting the Development of Industrial Clusters

3. Collaboration among SMEs to Establish Enterprise Networks

- Two steps for promoting collaboration among SMEs:

  ---Holding of SME Collaboration Meetings

  ---Assisting SMEs in building practical collaboration

- Encouraging the formation of regional industrial clusters to promote local economic development

  ---Target industrial groups that consist of 12 or more enterprises located in the same area.

10

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Policies for Promoting the Development of Industrial Clusters

4. Business Incubation Policy

- There are 88 incubators in Chinese Taipei. More than 1,900 incubatees have been nurtured since1996.
- Most incubators in Chinese Taipei are academic incubators and are located in universities. They play an important role in university-industry collaboration and serve as an important platform for cross-industry collaboration within the innovation system.
- Incubators disseminate knowledge and technology from academia to SMEs, promoting innovation in clusters and helping innovative SMEs incorporate into clusters.

11

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Policies for Promoting the Development of Industrial Clusters

5. Promoting Supply Chain Linkage for SMEs

- SMEA has launched a project aimed at helping SMEs in auto parts and components industry to build e-commerce capacity, and thereby integrate with multinationals' supply chains.
- The project aims to help 1,000 SMEs electronically connect to their partners in supply chains, and help 600 SMEs apply standard electronic frameworks to their supply chain management.
- Chinese Taipei helps SMEs establish industry-specific online databases. As of the end of 2003, 58 industries databases had been built, and an ERP model had been established.

12

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Concluding Remarks

- The industrial clusters policies adopted by Chinese Taipei are mainly market-oriented. The goals of these policies are to create a market mechanism that leads to the formation of industrial clusters.
- An industrial cluster should be dynamic and open to new firms. This openness to new firms is a major factor in the success of industrial clusters in Chinese Taipei.
- Government can support industrial cluster development by providing access to transportation infrastructure, encouraging firms to locate near clusters and communicate closely with other cluster firms.

13

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Thank You For Your Attention

14

Entrepreneurship, Cluster Formation and the Strategic Management of Places

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Paper prepared for presentation at the APEC Symposium on Industrial clustering for SMEs, Taipei, March 7-9, 2005

1.Introduction

Ever since Robert Solow (1956) based his model of economic growth on the neoclassical production function with its key factors of production, capital and labor, economists have relied upon the model of the production function as a basis for explaining the determinants of economic growth. Paul M. Romer's (1986) critique of the Solow approach was not with the basic model of the neoclassical production function, but rather what he perceived to be omitted from that model – knowledge. Not only did Romer (1986), along with Robert E. Lucas (1988) and others argue that knowledge was an important factor of production, along with the traditional factors of labor and capital, but because it was endogenously determined as a result of externalities and spillovers, it was particularly important.

The recognition that knowledge is a key factor determining competitiveness and economic growth was accompanied by two developments that were largely unanticipated. The first was the (re-) emergence of the importance of regions and geographic proximity as important units of economic activity. The second was that much of the innovative activity is less associated with footloose multinational corporations and more associated with high-tech innovative regional clusters, such as Silicon Valley, Research Triangle and Route 122. Only a few years ago the conventional wisdom predicted that globalization would render the demise of the region as a meaningful unit of economic analysis. According to *The Economist*, "The death of distance as a determinant of the cost of communications will probably be the single most economic force shaping society in the first half of the next century." Yet the obsession of policy-makers around the globe to "create the next Silicon Valley" reveals the increased importance of geographic proximity and regional agglomerations.

The rediscovery of the importance of geographic proximity in shaping economic performance has not escaped the attention of scholars. In proposing a new theory of economic geography, Paul Krugman, (1991, p. 55) asks, "What is the most striking feature of the geography of economic activity? The short answer is surely concentration...production is remarkably concentrated in space." A careful and systematic series of empirical studies provided evidence that what Krugman observed to be true for production was even more pronounced for innovative activity. This finding helped trigger a new literature with the goal of *understanding the spatial dimension of innovative activity*, specifically the determinants and mechanisms that underlie the propensity of innovative activity to cluster spatially. Knowledge spillovers figure prominently in addressing these issues

Even as scholars assembled the requisite theoretical frameworks and empirical analyses to reach conclusions with a high degree of confidence about the importance of geographic location, agglomerations and clusters for competitiveness and growth, they began to question the role that the organization and structure of economic activities play within spatially bounded regions. The purpose of this paper is to identify what has been learned in this new literature on the organization and structure of activities within geographic clusters, and in particular the two key dimensions which have been analyzed the most – specialization and diversity.

Section two draws on the literature that analyzes the economics of innovation and technological change to identify the factors that are most important for innovative activity. This literature has focused largely on the model of the knowledge production function, which was essentially *aspatial* in that it is insensitive to issues involving location and geography. However, empirical results hinted that knowledge production had a spatial dimension. Armed with a new theoretical understanding about the role and significance of knowledge spillovers, and the manner in which they are localized, scholars began to estimate the knowledge production function with a spatial dimension.

Section three explains how location and geographic space have become key factors in explaining the determinants of innovation and technological change. The fourth section examines studies that have sought to penetrate the black box of geographic space by addressing a limitation inherent in the model of the knowledge production. These studies have identified the important role that specialization and diversity can play in shaping the growth and international competitiveness of regional clusters. Finally, in the last section a summary and conclusions are provided. In particular, the findings of this paper suggest that a new policy approach of fostering diversity is essential for the strategic management of regions.

2. Innovation and the Knowledge Production Function

The traditional starting point in the literature on innovation and technological change for most theories of innovation has been the firm (Baldwin and Scott 1987, Cohen and Levin 1989, Scherer 1984 and 1991, and Griliches 1979). In such theories firms are exogenous and their performance in generating technological change is endogenous (Scherer, 1984 and 1991, Cohen and Klepper, 1991 and 1992). For example, in the most prevalent model of technological change, the model of the knowledge production function (Griliches 1979), incumbent firms engage in the pursuit of new economic knowledge as an input into the process of generating innovative activity. The most important input in this model is new economic knowledge. As Cohen and Klepper (1991 and 1992) point out, the greatest source generating new economic knowledge is generally considered to be R&D. Other inputs in the knowledge production function have included measures of human capital, skilled labor, and educational levels. Thus, the model of the knowledge production function from the literature on innovation and technological change can be represented as

$$I_i = \alpha RD_i^{\beta} HK_i^{\gamma} \varepsilon_i \qquad (1)$$

where *I* stands for the degree of innovative activity, *RD* represents R&D inputs, and *HK* represents human capital inputs. The unit of observation for estimating the model of the knowledge production function, reflected by the subscript i, has been at the level of countries, industries and enterprises.

The logic of the production function held: innovative output was a function of innovative inputs. However, empirical estimation of the model of the knowledge production function, represented by Equation 1, was found to be stronger at broader levels of aggregation such as countries or industries. For example, at the unit of observation of countries, the empirical evidence (Griliches 1984) clearly supported the existence of the knowledge production function. This is intuitively understandable, because the most innovative countries are those with the greatest investments to R&D. Less innovative output is associated with developing countries, which are characterized by a paucity of new economic knowledge. Similarly, the model of the knowledge production function was strong at the level of the industry (Scherer 1982; Griliches 1984). Again, this seems obvious as the most innovative industries also tend to be characterized by considerable investments in R&D and new economic knowledge Not only are industries such as computers, pharmaceuticals and instruments high in R&D inputs that generate new economic knowledge, but also in terms of innovative outputs (Scherer 1983; Acs and Audretsch 1990). By contrast, industries with little R&D, such as wood products, textiles and paper, also tend to produce only a negligible amount of innovative output.

Where the relationship became less robust was at the disaggregated microeconomic level of the enterprise, establishment, or even line of business: there is no direct deterministic relationship between inputs and innovation.[1] Thus, the finding that the knowledge production model linking knowledge generating inputs to outputs holds at the more aggregated levels of economic activity suggests the presence of an externality.

The model of the knowledge production function also became less compelling in view of a wave of studies that found that small enterprises were an engine of innovative activity in certain industries. For example, Acs and Audretsch (1988 and 1990) found that while large enterprises (defined as having at least 500 employees) generated a greater number of new product innovations than did small firms (defined as having fewer than 500 employees), once the measures were standardized by levels of employment, the innovative intensity of small enterprises was found to exceed that of large firms.[2] These results are startling, because as Scherer (1991) documented, the

[1] For example, while Acs and and Audretsch (1988 and 1990) found that the simple correlation between R&D inputs and innovative output was 0.84 for four-digit standard industrial classification (SIC) manufacturing industries in the United States, it was only about half, 0.40 among the largest U.S. corporations.

[2] The innovation rates, or the number of innovations per thousand employees, have the advantage of measuring large- and small-firm innovative activity relative to the presence of large and small firms in any given industry. That is, in making a direct comparison between large- and small-firm innovative activities, the absolute number of innovations contributed by large firms and small enterprises is somewhat misleading, since these measures are not standardized by the relative presence of large and small firms in each industry. When a direct comparison is made between the innovative activity of large and small firms, the innovation rates are presumably a more reliable measure of innovative intensity because they are weighted by the relative presence of small and large enterprises in any given industry. Thus, while large firms in manufacturing introduced 2,445 innovations, and small firms

bulk of industrial R&D is undertaken in the largest corporations; and small enterprises account only for a minor share of R&D inputs. This raises the question of *how small firms obtained access to R&D inputs*. Either the model of the knowledge production did not hold, at least at the level of the enterprise (for a broad spectrum across the firm-size distribution), or else the appropriate unit of observation had to be reconsidered. In searching for a solution, scholars chose the second interpretation, leading them to move towards spatial units of observation as an important unit of analysis for the model of the knowledge production function.

3. Knowledge Spillovers and the (Re)Emergence of Regional Clusters

As it became apparent that the firm was not completely adequate as a unit of analysis for estimating the model of the knowledge production function, scholars began to look for externalities. In refocusing the model of the knowledge production to a spatial unit of observation, scholars confronted two challenges. The first one was theoretical. What was the theoretical basis for knowledge to spill over yet, at the same time, be spatially within some geographic unit of observation? The second challenge involved measurement. How could knowledge spillovers be measured and identified? More than a few scholars heeded Krugman's warning (1991, p. 53) that empirical measurement of knowledge spillovers would prove to be impossible because "knowledge flows are invisible, they leave no paper trail by which they may be measured and tracked."[3]

In confronting the first challenge, which involved developing a theoretical basis for geographically bounded knowledge spillovers, scholars turned to the

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contributed slightly fewer, 1,954, small-firm employment was only half as great as large-firm employment, yielding an average small-firm innovation rate in manufacturing of 0.309, compared to a large-firm innovation rate of 0.202.

[3] Lucas (2001) , and Lucas and Rossi-Hansberg (2002) impose a spatial structure on production externalities in order to model the spatial structure of cities. The logic is that spatial gradients capture some of the externalities associated with localized human capital accumulation.

emerging literature of the new growth theory. In explaining the increased divergence in the distribution of economic activity between countries and regions, Krugman (1991) and Romer (1986) relied on models based on increasing returns to scale in production. By increasing returns, however, Krugman and Romer did not necessarily mean at the level of observation most familiar in the industrial organization literature – the plant, or at least the firm – but rather at the level of a spatially distinguishable unit. In fact, it was assumed that the externalities across firms and even industries would generate increasing returns in production. In particular, Krugman (1991), invoking Marshall (1920), focused on convexities arising from spillovers from (1) a pooled labor market; (2) pecuniary externalities enabling the provision of nontraded inputs to an industry in a greater variety and at lower cost; and (3) information or technological spillovers.

That knowledge spills over was barely disputed. Some thirty years earlier, Arrow (1962) identified externalities associated with knowledge due to its non-exclusive and non-rival use. However, what has been contested is the geographic range of knowledge spillovers: knowledge externalities are so important and forceful that there is no reason that knowledge should stop spilling over just because of borders, such as a city limit, state line, or national boundary. Krugman (1991), and others, did not question the existence or importance of such knowledge spillovers. In fact, they argue that such knowledge externalities are so important and forceful that there is no reason for a political boundary to limit the spatial extent of the spillover.

In applying the model of the knowledge production function to spatial units of observation, theories of why knowledge externalities are spatially bounded were needed. Thus, it took the development of localization theories explaining not only that knowledge spills over but also why those spillovers decay as they move across geographic space. An older but insightful literature addressed these concerns.

Jacobs (1969), writing about cities, suggests that i*nformation*, such as the price of gold on the New York Stock Exchange, or the value of the Yen in London, has a familiar meaning and interpretation. By contrast, *knowledge* or what is sometimes referred to as *tacit knowledge,* is vague, difficult to codify and often only serendipitously recognized. While information is codified and can be formalized, written down, tacit knowledge, by definition, is non-codifiable and cannot be formalized and written down. Geographic proximity matters in transmitting knowledge, because tacit knowledge is inherently non-rival in nature, and knowledge developed for any particular application can easily spill over and have economic value in very different applications. Manski (2000) considers that many of the interactions in R&D and human capital formation that are important to endogenous growth theory occur in non-market environments and are influenced by the expectations, preferences and constraints of related economic agents. Moreover, social interactions have economic value in transmitting knowledge and ideas. Von Hipple (1994) explains that high context, uncertain knowledge, or what he terms *sticky knowledge*, is best transmitted via face-to-face interaction and through frequent and repeated contact. An implication of the distinction between information and tacit knowledge is that the marginal cost of transmitting information across geographic space has been rendered invariant by the revolution in telecommunications while *the marginal cost of transmitting knowledge, especially tacit knowledge, is lowest with frequent social interaction, observation and communication.* After all, geographic proximity matters in transmitting knowledge, because as Glaeser, Kallal, Scheinkman and Shleifer

(1992, p.1126) observe, "intellectual breakthroughs must cross hallways and streets more easily than oceans and continents."

Audretsch and Feldman (1996) developed the theory that location mitigates the inherent uncertainty of innovative activity: *proximity enhances the ability of firms to exchange ideas and be cognizant of important incipient knowledge*, hence reducing uncertainty for firms that work in new fields. Innovation clusters spatially where knowledge externalities reduce the costs of scientific discovery and commercialization. In addition, Audretsch and Feldman (1996) suggest that firms producing innovations tend to be located in areas where there are necessary resources: resources that have accumulated due to a region's past success with innovation. In this way, firms and resources are endogenous.

Studies identifying the extent of knowledge spillovers are based on the model of the knowledge production function applied at spatial units of observation. Audretsch and Feldman (1996) found that the propensity of innovative activity to cluster geographically tends to be greater in industries where new economic knowledge plays a more important role. This effect was found to hold even after holding the degree of production at that location constant. Audretsch and Feldman (1996), follow Krugman's (1991) example, and calculate Gini coefficients for the geographic concentration of innovative activity to test this relationship.[4] The results

[4] The Gini coefficients are weighted by the relative share of economic activity located in each state. Computation of weighted Gini coefficients enables us to control for size differences across states. The Gini coefficients are based on the share of activity in a state and industry relative to the state share of the national activity for the industry. The locational Gini coefficients for production are based on industry value-added. We calculate the amount of value added in an industry and a state divided by national value-added for the industry. This ratio is normalized by the state share of total manufacturing value-added in order to account for the overall distribution of manufacturing activity. An industry which is not geographically concentrated more than is reflected by the overall distribution of manufacturing value-added would have a coefficient of 0. The closer the industry coefficient is to 1, the more geographically

indicate that a key determinant of the extent to which the location of production is geographically concentrated is the relative importance of new economic knowledge in the industry. Even after controlling for the geographic concentration of production, the results suggest a greater propensity for innovative activity to cluster spatially in industries in which industry R&D, university research and skilled labor are important inputs. In this work, skilled labor is included as a mechanism by which knowledge spillovers may be realized as workers move between jobs in an industry taking their accumulated skills and know-how with them.

In sum, *the empirical evidence suggests that location and proximity clearly matter in exploiting knowledge spillovers*. The geographic estimation of the knowledge production function, however, is limited because there is no understanding of the way in which spillovers occur and are realized at the geographic level. The pre-existing pattern of technology related activities makes it difficult to separate spillovers from the correlation of variables at the geographic level. Economic activity may be co-located, but the pattern of causality is difficult to decipher.

4. The Role of Spatial Organization

The contribution of the new wave of studies described in the previous section was simply to shift the unit of observation away from firms to a geographic region. But does it make a difference how economic activity is organized within the black box of geographic space? Geographers, political scientists and sociologists have long argued that the differences in the culture of a region and relationships between actors may contribute to differences in innovative performance across regions, even holding

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concentrated the industry would be. Cases is which data are suppressed are omitted from the analysis. The Gini Coefficients for innovation are based on counts of innovation in a state and industry are calculated in a similar way.

knowledge inputs such as R&D and human capital constant (see, Malecki 1997 for a review of the literature). For example, Saxenian (1994) argues that a culture of greater interdependence and exchange among individuals in the Silicon Valley region has contributed to a superior innovative performance than is found around Boston's Route 128, where firms and individuals tend to be more isolated and less interdependent.

Such observations suggest a limitation inherent to the general knowledge production function approach described in the previous section. While economists tend to avoid attributing differences in economic performance to cultural differences, there has been a series of theoretical arguments suggesting that differences in the underlying structure between regions may account for differences in rates of growth and technological change. In fact, a heated debate has emerged in the literature about the manner in which the underlying economic structure within a geographic unit of observation might shape economic performance (see Rosenthal and Strange in this volume). In this section we review the debate that revolves around two key structural elements – the degree of diversity versus specialization and the degree of monopoly versus local competition.

One view, which Glaeser, Kallal, Scheinkman and Shleifer (1992) attribute to the *Marshall-Arrow-Romer externality*, suggests that an increased concentration of a particular industry within a specific geographic region facilitates knowledge spillovers across firms. This model formalizes the insight that the concentration of an industry within a city promotes knowledge spillovers among firms and therefore facilitates innovative activity. To the degree that individuals in the population are identical and engaged in identical types of activities, the costs of communication and transactions are minimized. Lower costs of transaction in communication result in a higher probability of knowledge spilling over across individuals within the population. An important assumption of the model is that knowledge externalities with respect to firms exist, but only for firms within the same industry. Thus, the relevant unit of observation is extended from the firm to the region in the tradition of the Marshall-Arrow-Romer model, but the spillovers are limited to occur solely within the relevant industry.

By contrast, restricting knowledge externalities to occur only within the same industry may ignore an important source of new economic knowledge – inter-industry knowledge spillovers. After all, Griliches (1992, p. 29) defined knowledge spillovers as, "working on similar things and hence benefiting much from each others research." Jacobs (1969) argues that the most important source of knowledge spillovers is external to the industry in which the firm operates and that cities are the source of considerable innovation because the diversity of these knowledge sources is greatest in cities. According to Jacobs, it is the exchange of complementary knowledge across diverse firms and economic agents which yield a greater return on new economic knowledge. She develops a theory that emphasizes that the variety of industries within a geographic region promotes knowledge externalities and ultimately innovative activity and economic growth.[5]

The extent of regional specialization versus regional diversity in promoting knowledge spillovers is not the only dimension over which there has been a theoretical debate. A second controversy involves the degree of competition prevalent in the region, or the extent of local monopoly. The Marshall-Arrow-Romer model predicts that local monopoly is superior to local competition because it maximizes the ability of firms to appropriate the economic value accruing from their investments in new knowledge. By contrast, Jacobs (1969) and Porter (1990) argue the opposite –

[5] For an extension see Henderson (1994) , Henderson et al. (1995) and Rosenthal and Strange (2003).

that competition is more conducive to knowledge externalities than is local monopoly.[6] It should be emphasized that by local competition Jacobs does not mean competition within product markets as has traditionally been envisioned within the industrial organization literature. Rather, Jacobs is referring to the competition for the new ideas embodied in economic agents. Not only do an increased number of firms provide greater competition for new ideas, but in addition, greater competition across firms facilitates the entry of a new firm specializing in some particular new product niche. This is because the necessary complementary inputs and services are likely to be available from small specialist niche firms but not necessarily from large, vertically integrated producers.

A test of the specialization versus diversity debate measured economic performance in terms of employment growth. Glaeser, Kallal, Sheinkman and Schleifer (1992) employ a data set on the growth of large industries in 170 cities between 1956 and 1987 in order to identify the relative importance of the degree of regional specialization, diversity and local competition play in influencing industry growth rates. The authors find evidence that contradicts the Marshall-Arrow-Romer model but is consistent with the theories of Jacobs. However, their study provided no direct evidence as to whether diversity is more important than specialization in generating innovative activity.

Feldman and Audretsch (1999) identify the extent to which the organization of economic activity is either concentrated, or alternatively consists of diverse but complementary economic activities, and how the underlying structure of economic activity influences innovative output. They link the innovative output of product categories within a specific city to the extent to which the economic activity of that

[6] Porter (1990) provides examples of Italian ceramics and gold jewelry as industries in which numerous firms are located within a bounded geographic region and compete intensively for new ideas.

city is concentrated in that industry, or conversely, diversified in terms of complementary industries sharing a common science base. Feldman and Audretsch (1999) identify the extent to which the organization of economic activity is either concentrated, or alternatively consists of diverse but complementary economic activities, and how the underlying structure of economic activity influences innovative output. They link the innovative output of product categories within a specific city to the extent to which the economic activity of that city is concentrated in that industry, or conversely, diversified in terms of complementary industries sharing a common science base.

Romer (1986), Lucas (1988 and 1993) and Grossman and Helpman (1991) established that knowledge spillovers are an important mechanism underlying endogenous growth. However, they shed little light on the actual mechanisms by which knowledge is transmitted across firms and individuals. By necessity, the knowledge production function focused on the quantifiable aspects of innovation. However, formal R&D data ignore the complex processes of technological accumulation whereby tacit knowledge is built up and accumulates meaning – complex transactions that involves local institutions, social convention and legal rights as well as economic interests (Feldman et al. 2002). Thus, *the literature on knowledge spillovers and the geography of innovation has begun to consider the mechanisms by which knowledge spills over and is put into economic use and the degree to which these process are geographically localized*. Understanding these issues are important because a policy implication commonly drawn from the new economic growth theory is that, as a result of convexities in knowledge and the resultant increasing returns, knowledge resources, such as R&D should be publicly supported. While this may be valid, it is also important to recognize that the mechanisms for spillover transmission may also play a key role and may also serve as a focus for public policy enhancing economic growth and development.

The concepts of localized knowledge spillovers and absorptive capacity – the ability of economic agents to recognize, assimilate and apply new scientific knowledge, are closely linked (Agrawal 2000a and 2000b). Cohen and Levinthal (1989 and1990) suggest that firms that invest in R&D develop the capacity to adapt knowledge developed in other firms and are therefore able to appropriate some of the returns accruing to external investments in new knowledge. Cockburn and Henderson (1998) build on this concept to suggest that firms that are connected to the community of open science are able to increase their investment in R&D by absorbing knowledge spillovers. Firms are able to acquire and benefit from external knowledge by cultivating relationships with universities, participating in research consortia and partnering with academics that do related scientific work.

Edwin Mansfield was perhaps the earliest to point out that research laboratories of universities provide one source of innovation-generating knowledge that is available to private enterprises for commercial exploitation (Mansfield 1995, 1998). The empirical work reviewed previously supported that finding. For example, Jaffe (1989) and Acs, Audretsch, and Feldman (1992), Audretsch and Feldman (1996) and Feldman and Audretsch (1999) found that the knowledge created in university laboratories spills over to contribute to the generation of commercial innovations by private enterprises. Even after controlling for the location of industrial R&D, knowledge created at universities results in greater innovation. The ability of research universities to create benefits for their local economies has created a new mission for research universities and a developing literature examines the mechanism and the process of technology transfer from research universities (Mowery and Shane 2002).

A different literature has emphasized the impact of networks and social capital found within a geographic region. Relational networks exist at multiple levels of analysis because they can link together individuals, groups, firms, industries, geographic regions, and nation-states. In addition, they can tie members of any one of these categories to members of another category. For example, Powell et al., (1996), Florida and Cohen (1999) and Feldman et. al. (2002) demonstrate the ways in which research universities provide a link that facilitates knowledge spillovers in the form of recruiting talent to the region, transferring technology through local linkages and interactions, placing students in industry, and providing a platform for firms, individuals and government agencies to interact. Similarly, Florida and Kenney (1988), examine the connections and special access to talent and resources that venture capital firms provide to link their new high technology startups clients. Gompers and Lerner (1999) have shown how geography affects the location of venture capital. In particular, they show that the geographic distribution of venture capital is highly spatially skewed with California, New York, and New England as the major location of venture capital funds. Furthermore, Sorenson and Stuart (2001) show that location matters in obtaining venture capital. By analyzing the determinants of venture capital investment in the United States between 1986 and 1998, they find that the likelihood of a venture capitalist investing in a given target declines with geographical distance between the venture capitalist and the company.

Malecki (1997) was perhaps the first to note *the importance of skilled labor as a mechanism for knoweldge transfer in technology based industrial clusters*. It is also the case that for certain science based industries that the location and preferences of scientists influence the geographical location of innovation. Zucker, Darby and Brewer (1998) and Prevenzer (1997) show that in biotechnology, an industry based almost exclusively on new knowledge and cutting edge scientific discoveries, firms tend to cluster together in just a handful of locations and find that this is due to the location of star scientists – those individuals with high amounts of human capital who are able to appropriate their knowledge thorugh start-up firms. This finding is supported by Audretsch and Stephan (1996) who examine the geographic relationships of scientists working with biotechnology firms. The importance of geographic proximity is clearly shaped by the role played by the scientist. The scientist is more likely to be located in the same region as the firm when the relationship involves the transfer of new economic knowledge. However, when the scientist is providing a service to the company that does not involve knowledge transfer, local proximity becomes much less important.

The literature identifying mechanisms actually transmitting knowledge spillovers is sparse and remains underdeveloped. However, one important area where such transmission mechanisms have been identified is entrepreneurship. Entrepreneurship is concerned with the startup and growth of new enterprises.

Why should entrepreneurship serve as a mechanism for the spill over of knowledge from the source of origin? At least two major channels or mechanisms for knowledge spillovers have been identified in the literature. Both of these spillover mechanisms revolve around the issue of appropriability of new knowledge and absorptive capacity. This view of spillovers is consistent with the traditional model of the knowledge production function, where the firm exists exogenously and then undertakes (knowledge) investments to generate innovative output.

By contrast, Audretsch (1995) proposes shifting the unit of observation away from exogenously assumed firms to individuals, such as scientists, engineers or other knowledge workers – agents with endowments of new economic knowledge. When the lens is shifted away from the firm to the individual as the relevant unit of observation, the appropriability issue remains, but the question becomes, *How can economic agents with a given endowment of new knowledge best appropriate the returns from that knowledge?* If the scientist or engineer can pursue the new idea within the organizational structure of the firm developing the knowledge and appropriate roughly the expected value of that knowledge, he has no reason to leave the firm. On the other hand, if he places a greater value on his ideas than do the decision-making bureaucracy of the incumbent firm, he may choose to start a new firm to appropriate the value of his knowledge. Small enterprises can compensate for their lack of R&D is through spillovers and spin-offs. Typically an employee from an established large corporation, often a scientist or engineer working in a research laboratory, will have an idea for an invention and ultimately for an innovation. Accompanying this potential innovation is an expected net return from the new product. The inventor would expect to be compensated for his/her potential innovation accordingly. If the company has a different, presumably lower, valuation of the potential innovation, it may decide either not to pursue its development, or that it merits a lower level of compensation than that expected by the employee.

In either case, the employee will weigh the alternative of starting his/her own firm. If the gap in the expected return accruing from the potential innovation between the inventor and the corporate decision maker is sufficiently large, and if the cost of starting a new firm is sufficiently low, the employee may decide to leave the large corporation and establish a new enterprise. Since the knowledge was generated in the established corporation, the new start-up is considered to be a spin-off from the existing firm. Such start-ups typically do not have direct access to a large R&D

laboratory. Rather, these small firms succeed in exploiting the knowledge and experience accrued from the R&D laboratories with their previous employers.

In the metaphor provided by Albert O. Hirschman (1970), if voice proves to be ineffective within incumbent organizations, and loyalty is sufficiently weak, a knowledge worker may resort to exit the firm or university where the knowledge was created in order to form a new company. In this spillover channel the knowledge production function is actually reversed. The knowledge is exogenous and embodied in a worker. The firm is created endogenously in the worker's effort to appropriate the value of his knowledge through innovative activity.

One group of studies has focused on how location has influenced the entrepreneurial decision, or the decision to start a new firm. Within the economics literature, the prevalent theoretical framework has been the general model of income choice. The model of entrepreneurial choice dates back at least to Knight (1921), but was more recently extended and updated by Lucas (1978), Kihlstrom and Laffont (1979), Holmes and Schmidt (1990) and Jovanovic (1994). In its most basic rendition, individuals are confronted with a choice of earning their income either from wages earned through employment in an incumbent enterprise or else from profits accrued by starting a new firm. The essence of the entrpereurial choice model is made by comparing the wage an individual expects to earn through employment, W*, with the profits that are expected to accrue from a new-firm startup, P*. Thus, the probability of starting a new firm, Pr(s), can be represented as

$$Pr(s) = f(P^* - W^*) \tag{3}$$

The model of entrepreneurial choice has been extended by Kihlstrom and Laffont (1979) to incorporate aversion to risk, and by Lucas (1978) and Jovanovic (1994) to explain why firms of varying size exist, and has served as the basis for empirical studies of the decision to start a new firm by Evans and Leighton (1989a, 1989b and 1990).

Geographic location should influence the entrepreneurial decision by altering the expected return from entrepreneurial activity, P*. The theory of knowledge spillovers suggests that P* will tend to be greater in agglomerations and spatial clusters, since access to tacit knowledge is greater. Geography and spatial location also influences entrepreneurship. The important role that geographic clusters and networks play as a determinant of entrepreneurial activity was identified in Europe and only recently has been discovered within the North American context (Porter, 1990 and 2000; Saxenien, 1994). By contrast, there is a longer and richer tradition of research linking entrepreneurship to spatial clusters and networks in Europe. However, most of these studies have been in social science fields other than economics. For example, Becattini (1990) and Brusco (1990) identified the key role that spatial clusters and networks play in promoting SMEs in Italy. With the development of recent theoretical models by Soubeyran and Thisse (1999) and Soubeyran and Weber (2002), it became clear and accepted that spatial agglomerations were also important in the North American context.

An important distinction between the European literature and the emerging literature in North America was the emphasis on high technology and knowledge spillovers in the North American context. By contrast, the European tradition focused much more on the role of networks and clusters in fostering the viability of SMEs in traditional industries, such as textiles, apparel and metalworking. For example, seminal studies by Becattini (1990) and Brusco (1990) argue that small and new firms enjoy a high degree of stability when supported by networks in Italy. A rich literature has provided a body of case studies, spanning the textile industries of northern Italy to the metal working firms of Baden Wuerttenberg (Piore and Sabel, 1984), documenting the long-term viability and stability of small and new firms embedded in the so-called industrial districts of Europe. Pyke and Sengenberger (1990) argue that through the support of an industrial district, small firms in European spatial clusters have been able to compensate for what would otherwise be an inherent size disadvantage. According to Pyke and Sengenberger (1990), an industrial district is a geographically defined production system, involving a large number of enterprises engaging in production at a wide range of stages, and typically involved in the production of a homogeneous product. A particularly significant feature of Italian industrial districts is that almost all of the firms are small or even micro-enterprises. Examples of such industrial districts include Prato, Biella, Carpi and Castelgoffredo, which specialize in textile (coolants in Castelgoffredo); Vigevano, Montebellune and Montegranaro where shoes are manufactured (ski boots in Montebellune); Pesaro and Nogara which manufacture wooden furniture; Sassuolo where ceramic tiles are produced.

Brusco (1990) emphasizes the cooperation among network firms within an industrial district. Such cooperation presumably reduces any size-inherent disadvantages and improves the viability of small firms operating within the network. According to Pyke and Sengenberger (1990, p. 2), "A characteristic of the industrial district is that it should be conceived as a social and economic whole. That is to say, there are close inter-relationships between the different social, political and economic spheres, and the functioning of one, say the economic, is shaped by functioning and organization of the others." Grabher (1993) similarly argues that the social structure underlying industrial networks contributes to the viability of small firms that would otherwise be vulnerable if they were operating in an isolated context.

Feldman (2001) and Feldman and Francis (2001) examine the formation of innovative clusters and argue that entrepreneurs are key agents. Based on an analysis of the development of an Internet and biotechnology cluster around Washington, D.C., Feldman (2001) provides evidence that clusters form not because resources are initially located in a particular region, but rather through the work of entrepreneurs. Entrepreneurship is a local phenomenon as most entrepreneurs were previously employed in the region. Moreover, entrepreneurs are endogenous and organize resources and institutions to support their firms. An industry agglomeration is simply a collection of localized firms with a common focus and there are gains to collective action. As their businesses begin to thrive, resources such as money, networks, experts, and related services develop in, and are attracted to, the region. With this infrastructure in place, more entrepreneurial ventures locate and thrive in the region, which ultimately may create a thriving cluster where none previously existed. Feldman and Francis (2001) develop a conceptual model to formalize the process of cluster formation through entrepreneurism. Using simulations, Zhang (2002) demonstrates how a small number of successful entrepreneurs can generate a cluster.

A series of studies, spanning a broad spectrum of countries, has attempted to link entrepreneurial activity to characteristics specific to a geographic region, including measures of knowledge, such as R&D and human capital. Entrepreneurship activity has been typically measured as new-firm startups (rates), self-employment (rates), business ownership (rates), or a combination of startups and exits referered to as turbulence (rates). For example, the collection of European country studies included in the special issue of *Regional Studies* on “Regional Variations in New Firm Formation” (Reynolds, Storey and Westhead, 1994), along with the survey by Storey (1991) suggest that the empirical evidence has been generally unambiguous with respect to the findings for population density (a positive impact on startup rates), population growth (positive impact on startup rates), skill and human capital levels of the labor force (positive impact), and mean establishment size (negative impact on startup rates). By contrast, the empirical evidence about the impact of unemployment on startup rates is considerably more ambiguous. But an unambiguous positive relationship has emerged between measures of human capital and entrepreneurial activity at the regional level.[7]

Audretsch and Fritsch (1994) examined the impact that location plays on entrepreneurial activity in (West) Germany. Using a data base derived from the social insurance statistics, which covers about 90 percent of employment, they identify the birth rates of new startups for each of 75 distinct economic regions. These regions are distinguished on the basis of planning regions, or *Raumordungsregionen*. They find that, for the late 1980s, the birth rates of new firms are higher in regions experiencing low unemployment, which have a dense population, a high growth rate of population, a high share of skilled workers, and a strong presence of small businesses.

Similarly, Pfirrmann (1994) has found that the innovative activity of small- and medium-sized firms in West Germany is shaped by regional factors. He uses a database consisting of innovative small and medium-sized firms and finds that the innovative activity of small- and medium-sized enterprises tends to be greater in those regions where there is a strong presence of knowledge resources. However, his results also indicate that factors internal to the firm are more important for the innovation efforts of a small firm than is the regional environment.

If entrepreneurship serves as a mechanism for knowledge spillovers, it should not only be reflected by the model of entrepreneurial choice, or the decision to start a

[7] The positive relationship between entrepreneurship activity and economic growth could also be at least partially explained by the fact that a large number of entrepreneurs implies a greater number of firms and a stronger accumulation of physical capital.

new firm. Rather, measures of entrepreneurial activity should also be positively linked to the growth performance of regions. The view of entrepreneurship is based on its role as an agent of change in a knowledge-based economy implies that a positive economic performance should be linked to entrepreneurial activity. This hypothesis has raised two challenges to researchers: (1) What is meant by economic performance and how can it be measured and operationalized? and (2) Over which units of analysis should such a positive relationship between entrepreneurship and economic performance be manifested? In fact, these two issues are not independent from each other. The answer to the second question, the appropriate unit of analysis, has influenced the first question, the performance criteria and measure.

The most prevalent measures of performance has been employment growth. The most common and amost exclusive measure of performance is growth, typically measured in terms of employment growth. These studies have tried to link various measures of entrepreneurial activity, most typically startup rates, to economic growth. Other measures sometimes used include the relative share of SMEs, and self-employment rates.

For example, Audretsch and Fritsch (1996) analyzed a database identifying new business startups and exits from the social insurance statistics in Germany to examine whether a greater degree of turbulence leads to greater economic growth, as suggested by Schumpeter in his 1911 treatise, *A Theory of Economic Development*. These social insurance statistics are collected for individuals. Each record in the database identifies the establishment at which an individual is employed. The startup of a new firm is recorded when a new establishment identification appears in the database, which generally indicates the birth of a new enterprise. While there is some evidence for the United States linking a greater degree of turbulence at the regional level to higher rates of growth for regions (Reynolds, 1999), Audretsch and Fritsch (1996) find that the opposite was true for Germany during the 1980s. In both the manufacturing and the service sectors, a high rate of turbulence in a region tends to lead to a lower and not a higher rate of growth. They attribute this negative relationship to the fact that the underlying components – the startup and death rates – are both negatively related to subsequent economic growth. Those areas with higher startup rates tend to experience lower growth rates in subsequent years. Most strikingly, the same is also true for the death rates. The German regions experiencing higher death rates also tend to experience lower growth rates in subsequent years. Similar evidence for Germany is found by Fritsch (1997).

Audretsch and Fritsch (1996) conjectured that one possible explanation for the disparity in results between the United States and Germany may lie in the role that innovative activity, and therefore the ability of new firms to ultimately displace the incumbent enterprises, plays in new-firm startups. It may be that innovative activity did not play the same role for the German *Mittelstand* as it does for SMEs in the United States. To the degree that this was true, it may be hold that regional growth emanates from SMEs only when they serve as agents of change through innovative activity.

The empirical evidence suggested that the German model for growth provided a sharp contrast to that for the United States. While Reynolds (1999) had found that the degree of entrepreneurship was positively related to growth in the United States, a series of studies by Audretsch and Fritsch (1996) and Fritsch (1997) could not identify such a relationship for Germany. However, the results by Audretsch and Fritsch were based on data from the 1980s.

Divergent findings from the 1980s about the relationship between the degree of entrepreneurial activity and economic growth in the United States and Germany posed something of a puzzle. On the one hand, these different results suggested that the relationship between entrepreneurship and growth was fraught with ambiguities. No confirmation could be found for a general pattern across developed countries. On the other hand, it provided evidence for the existence of distinct and different national systems. The empirical evidence clearly suggested that there was more than one way to achieve growth, at least across different countries. *Convergence in growth rates seemed to be attainable by maintaining differences in underlying institutions and structures*.

However, in a more recent study, Audretsch and Fritsch (2002) find that different results emerge for the 1990s. Those regions with a higher startup rate exhibit higher growth rates. This would suggest that, in fact, Germany is changing over time, where the engine of growth is shifting towards entrerpeneurship as a source of growth. The results of their 2002 paper suggest a somewhat different interpretation. Based on the empirical evidence that the source of growth in Germany has shifted away from the established incumbent firms during the 1980s to entrepreneurial firms in the 1990s, it would appear that a process of convergence is taking place between Germany and the United States, where entrepreneurship provides the engine of growth in both countries. Despite remaining institutional differences, the relationship between entrepreneurship and growth is apparently converging in both countries.

The positive relationship between entrepreneurship and growth at the regional level is not limited to Germany in the 1990. For example, Foelster (2000) examines not just the employment impact within new and small firms but on the overall link between increases in self-employment and total employment in Sweden between

1976-1995. By using a Layard-Nickell framework, he provides a link between micro behavior and macroeconomic performance, and shows that increases in self-employment rates have had a positive impact on regional employment rates in Sweden.

Hart and Hanvey (1995) examine measures of new and small firms start-ups to employment generation in the late 1980s for three regions in the the United Kingdom. While they find that employment creation came largely from SMEs, they also identify that most of the job losses also came from SMEs.

Callejon and Segarra (1999) use a data set of Spanish manufacturing industries between 1980-1992 to link new-firm birth rates and death rates, which taken together constitute a measure of turbulence, to total factor productivity growth in industries and regions. They adopt a model based on a vintage capital framework in which new entrants embody the edge technologies available and exiting businesses represent marginal obsolete plants. Using a Hall type of production function, which controls for imperfect competition and the extent of scale economies, they find that both new-firm startup rates and exit rates contribute positively to the growth of total factor productivity in regions as well as industries.

The evidence linking entrepreneurship to growth at the regional level may actually be more convincing in the European context than in the North American context. Only a handful of studies have been undertaken for North America, while the evidence from Europe is considerably more robust and consistent.

In the U.S. a series of studies (Wilson 1996; Bates 1998) have attempted to identify whether the determinants of entrepreneurial activity differ for different immigrant and ethnic minority groups. In one of the most important studies, Saxenien (2001) documents that the decision to become an entrepreneur is shaped by immigrant group status. In particular, she provides evidence that the fastest-growing groups of immigrant engineers in Silicon Valley are from Mainland China and India. Chinese, in particular, are increasingly visible in the computer science and engineering departments on university campuses located in the Silicon Valley region. Saxenien (2001) suggests that these immigrant entrepreneurs provide a mechanism for a two-way flow of ideas and knowledge between Silicon Valley and their home regions in Asia.

5. Conclusions

Globalization is shifting the comparative advantage in the OECD countries away from being based on traditional inputs of production, such as land, labor and capital, towards knowledge. As the comparative advantage has become increasingly based on new knowledge, public policy has responded in two fundamental ways. The first has been to shift the policy focus away from the traditional triad of policy instruments essentially constraining the freedom of firms to contract—regulation, competition policy or antitrust in the U.S., and public ownership of business. The policy approach of constraint was sensible as long as the major issue was how to restrain large corporations in possession of considerable market power. That this policy is less relevant in a global economy is reflected by the waves of deregulation and privatization throughout the OECD.

Instead, a new policy approach is emerging which focuses on enabling the creation and commercialization of knowledge. Examples of such policies include encouraging R&D, venture capital and new-firm startups. The organization of knowledge activities within a region, and in particular, whether diversity or specialization of economic activities better promotes technological change, has been the subject of a heated debate in the economics literature. This paper has attempted to shed light on that debate by linking the extent of diversity versus specialization of economic activities to innovative output. By focusing on innovative activity for particular industries at specific locations, we find compelling evidence that specialization of economic activity does not promote innovative output. Rather, the results indicate that diversity across complementary economic activities sharing a common knowledge base is more conducive to innovation, and therefore economic growth and global competitiveness, than is specialization. In addition, the results from the literature indicate that the degree of local competition for new ideas within a city is more conducive to innovative activity than is local monopoly.

Scholars are increasingly learning that external sources of knowledge are critical to innovation. The growing empirical evidence suggests that the boundaries of the firm are but one means to organize and harness knowledge. An analogous means of organizing economic activity are spatially defined boundaries. Geographic location may provide another useful set of boundaries within which to organize innovation. Geography may provide a platform upon which knowledge may be effectively organized. Public policy devoted to generating economic growth, employment, and international competitiveness would be well advised to harness the potential of this economic platform offered by regional clusters.

References

Acs, Z. J. and D. B. Audretsch (1988), Innovation in large and small firms: an empirical analysis, *American Economic Review* 78: 678-690.

Acs, Z. J. and D. B. Audretsch (1990), *Innovation and Small Firms* (MIT Press, Cambridge).

Acs, Z. J., D.B. Audretsch and M. P. Feldman (1992), Real effects of academic research," *American Economic Review*, 82: 363-367.

Acs, Z. J., D. Audretsch and M. P. Feldman (1994), R&D spillovers and recipient firm size, *Review of Economics and Statistics* 100(1): 336-367.

Almeida, P. and B. Kogut, (1997), The exploration of technological diversity and the geographic localization of innovation," *Small Business Economics* 9(1): 21-31.

Arrow, K. (1962), Economic welfare and the allocation of resources for invention, in R. Nelson (ed.), *The Rate and Direction of Inventive Activity* (Princeton University Press, Princeton).

Audretsch, D.B. (forthcoming in 2005), *The Entrepreneurial Society* (Oxford University Press, New York).

Audretsch, D. B, M. Keilbach and E. Lehmann (2005), *Entrepreneurship and Economic Growth* (Oxford University Press, New York).

Audretsch, D. B. (1995), *Innovation and Industry Evolution* (MIT Press, Cambridge).

Audretsch, D. B. and M. P. Feldman, (1996), R&D spillovers and the geography of innovation and production, *American Economic Review* 86(4): 253-273.

Audretsch, D. B. and P. Stephan, (1996), Company-scientist locational links: the case of biotechnology, *American Economic Review* 86(4): 641-652.

Audretsch, D. B. and M. Fritsch (2002), Growth regimes over time and space, *Regional Studies* 36(2): 113-124.

Cohen, W. M. and D.A. Levinthal, (1989), Innovation and learning: the two faces of R&D, *Economic Journal* 99(3): 569-596.

Cohen,W. M. and S. Klepper, (1991), Firm size versus diversity in the achievement of technological advance, Z. J. Acs and D. B. Audretsch (eds), *Innovation and Technological Change: An International Comparison* (University of Michigan Press, Ann Arbor),183-203.

Cohen, W. M. and S. Klepper (1992), The tradeoff between firm size and diversity in the pursuit of technological progress, *Small Business Economics* 4(1): 1-14.

Ellsion, G. and E. E. Glaeser (1997), Geographic concentration in U.S. manufacturing industries: a dartboard approach,' *Journal of Political Economy* (4): 889-927.

Evans, D. S. and Linda S. Leighton (1989a), Some empirical aspects of entrepreneurship, *American Economic Review* 79(3), 519-535.

Evans, D. S. and L. S. Leighton, (1989b), The determinants of changes in U.S. self-employment, *Small Business Economics* 1(2): 11-120.

Evans, D. S. and L. S. Leighton, (1990), Small business formation by unemployed and employed workers, *Small Business Economics* 2(4): 319-330.

Foelster, S. (2000), Do entrepreneurs create jobs? *Small Business Economics* 14(2): 137-148.

Fritsch, M. (1997), New firms and regional employment change, *Small Business Economics* 9(5): 437-448.

Glaeser, E., H. Kallal, J. Scheinkman, and A.. Shleifer (1992), Growth of cities," *Journal of Political Economy* 100: 1126-1152.

Gompers, P.. and J. Lerner (1999), *The Venture Capital Cycle* (Cambridge, MIT Press: Cambridge).

Griliches, Z. (1979), Issues in assessing the contribution of R&D to productivity growth," *Bell Journal of Economics* 10: 92-116.

Griliches, Z. (1992), "The Search for R&D Spill-Overs," *Scandinavian Journal of Economics* 94: 29-47.

Griliches, Z., (1984), *R&D, Patents, and Productivity* (University of Chicago Press: Chicago).

Grossman, Gene M. and E. Helpman**, (**1991), *Innovation and Growth in the Global Economy*, (MIT Press, Cambridge, MA).

Hirschman, Albert O. (1970), *Exit, Voice, and Loyalty* (Harvard University Press, Cambridge).

Jacobs, J. (1969), *The Economy of Cities* (Random House, New York).

Jaffe, A. B., (1989), Real effects of academic research," *American Economic Review* 79(5): 957-970.

Jaffe, A.B., and M. Trajtenberg (2002), *Patents, citations, and innovations: a window on the knowledge economy*, (MIT Press: Cambridge).

Jaffe, A.B., M. Trajtenberg and R. Henderson (1993), Geographic localization of knowledge spillovers as evidenced by patent citations, *Quarterly Journal of Economics* 63: 577-598.

Jovanovic, B., (1994), Entrepreneurial choice when people differ in their management and labor skills, *Small Business Economics* 6(3): 185-192.

Kihlstrom, R. E. and J.J. Laffont (1979), A general equilibrium entrepreneurial theory of firm formation based on risk aversion, *Journal of Political Economy* 87(4): 719-748.

Knight, F.H,(1921), *Risk, Uncertainty and Profit*, (Houghton Mifflin: New York).

Krugman, P., (1991), *Geography and Trade*, (MIT Press: Cambridge).

Lucas, R. E. (2001), "Externalities and cities," *Review of Economic Studies*, 4: 245-274.

Lucas, R.E. (1993), "Making a miracle," *Econometrica*, 61: 251-272.

Lucas, R. E.(1988), On the mechanics of economic development, *Journal of Monetary Economic*, 22: 3-39.

Mansfield, E. (1995), Academic research underlying industrial innovations: sources, characteristics, and financing. *Review of Economics and Statistics* 77: 1:55-65.

Mansfield, E. (1998), Academic research and industrial innovation: an update of empirical finding,. *Research Policy* 26: 773-776.

Marshall. A., (1920), *Principles of Economis* (MacMillan, London).

Pfirrmann, O. (1994), The geography of innovation in small and medium-sized firms in West Germany, *Small Business Economics* 6(1): 27-41.

Porter, M. E., (2000), Locations, clusters, and company strategy, in G.L. Clark, M.P. Feldman and M.S. Gertler (Eds.), *The Oxford Handbook of Economic Geography*, (Oxford University Press, Oxford), 253-274.

Porter, M.E. (1990), *The Comparative Advantage of Nations* (Free Press, New York).

Powell, W., K.W. Koput, & L. Smith-Doerr (1996), Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology, *Administrative Science Quarterly* 42 (1): 116-145.

Prevenzer, M. (1997), The dynamics of industrial clustering in biotechnology, *Small Business Economics* 9(3): 255-271.

Romer, P. M. (1986), Increasing returns and long-run growth, *Journal of Political Economy* 94(5): 1002-37.

Saxenian, A. (2001), The role of immigrant entrepreneurs in new venture creation, in C. B. Schoonhoven and E. Romanelli (eds.), *The Entrepreneurship Dynamic* (Stanford University Press, Palo Alto), 40-67

Saxenien, A., (1994), *Regional Advantage* (Harvard University Press, Cambridge).

Schumpeter, J. A. (1911), *Theorie der wirtschaftlichen Entwicklung. Eine Untersuchung ueber Unternehmergewinn, Kapital, Kredit, Zins und den Konjunkturzyklus* (Duncker und Humblot, Berlin).

Von Hipple, E. (1994), Sticky information and the locus of problem solving: implications for innovation, *Management Science* 40: 429-439.

Zhang, J. (2002), Growing silicon valley on a landscape: an agent-based approach to high technology industrial clusters, Public Policy Institute of California.

Zucker, L.G., M.R. Darby, and M.B. Brewer (1998), Intellectual human capital and the birth of U.S. biotechnology enterprises, *American Economic Review* 88: 290-306.

Regional Clusters:
New Departures and Paradigms

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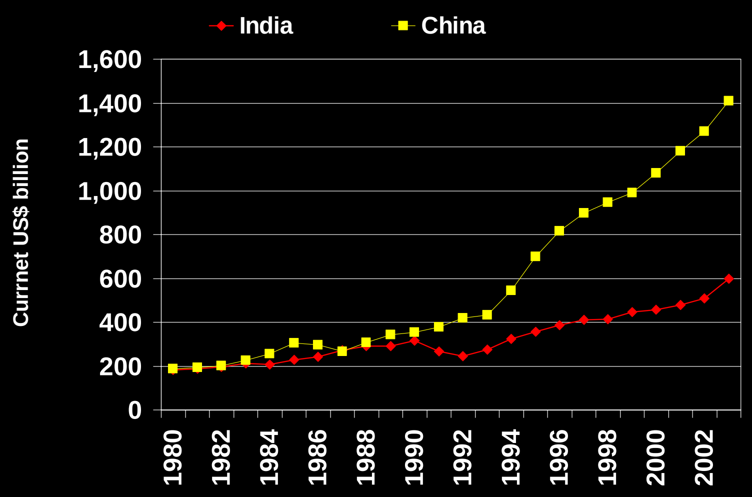
  - Greater competitive pressures
  - New players placing traditional clusters and paradigms at risk
  - Greater imperative to link locally and globally
  - Greater opportunity to link locally and globally
- The cluster response
  - Clusters are everywhere
  - Families of clusters
  - Industry and activity based clusters
  - Cluster nodes, networks, and the mini-metanational
  - Clusters and the creative economy

The rise of China and India



Source: World Bank

China displacing traditional clusters

- Garments
- Textiles
- Footwear
- Silk products
- Travel goods
- Housewares
- Pens and pencils
- Toys
- Cutlery
- Hardware
- Furniture
- Pianos

- Watches and clocks
- Consumer electronics
- Electronic components
- Notebook computers
- Home appliances
- Power tools
- Bicycles
- Motorcycles
- Containers
- Ships
- Cranes
- Etc., etc., etc.

But weren't earlier clusters resilient and competitive?

Building new systems in China

Domestic Market

Export Processing

Export Processing in "Higher Tech" Industries

Components
- Subassembly
- Simple components
- Advanced components
- Component technology

Capital Goods
- Service and repair
- Spare parts
- Individual machines
- Complete systems

Related Services
- Quality control
- Transport and Logistics
- Design/ Development
- Commercialization/ Mgmt

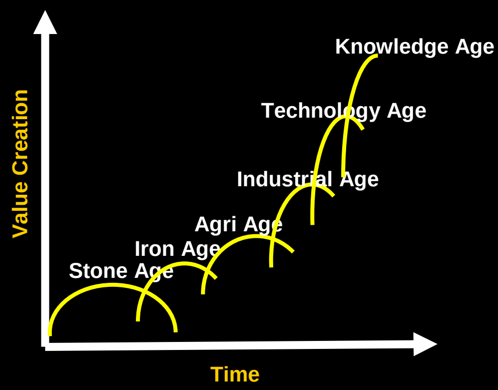
Raw Materials and Heavy Industry

Source: Michael Enright, Edith Scott, and Ka-Mun Chang, *Regional Powerhouse: The Greater Pearl River Delta and the Rise of China,* (Wiley, 2005).

India service and tech clusters

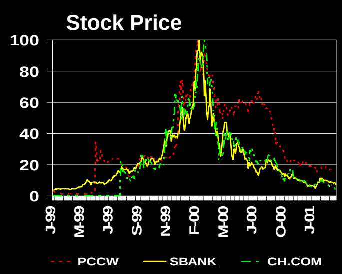
- **Modern technology and local talent are creating new opportunities**
  - Call centers
  - Back office operations
  - IT services
  - Research and development
  - Financial research
- **May prove more disruptive in some cases than China**
  - Competition for white collar jobs
  - Cutting into service-based

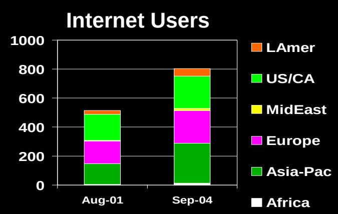
The emergence of the knowledge economy



- Commoditization of manufacturing
- Value in intangible assets
- Soft infrastructure critical
- Complexity / complementarity
- Real knowledge misunderstood

The Internet / IT revolution

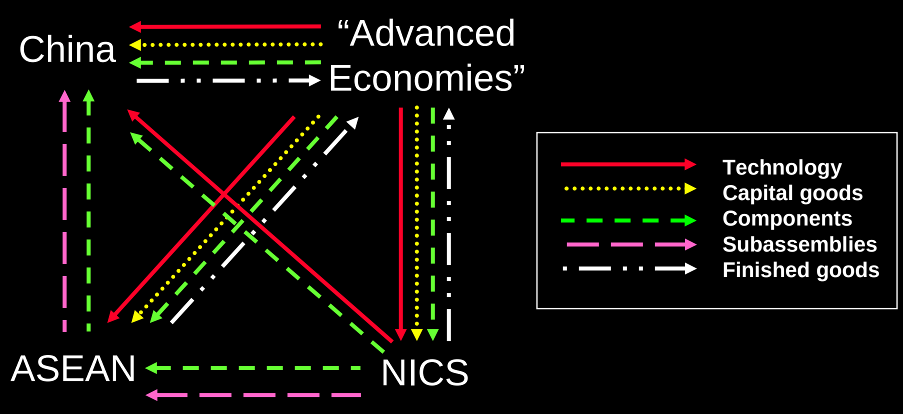




- Supercharged flows
- New ways to compete
- New ways to procure
- New ways to manage
- New geography of strategy
- New economies in the game

Sources: Sequencer, Datastream, Internetworldstats.com

Production relationships in East Asia



Challenges for SMEs and SME programs

- Greater competitive pressures
- New players placing traditional clusters and paradigms at risk
- Greater imperative to link locally and globally
- Greater opportunity to link locally and globally

- What we need are good cluster responses to the forces

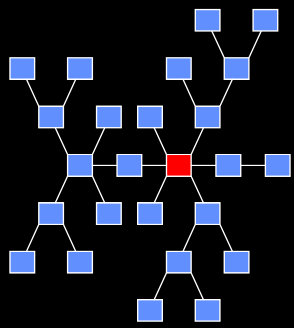
- To do this we must go beyond traditional cluster paradigms to get a richer understanding of clustering in the first place

Regional clusters are everywhere

- Small scale craft industries
- High technology agglomerations

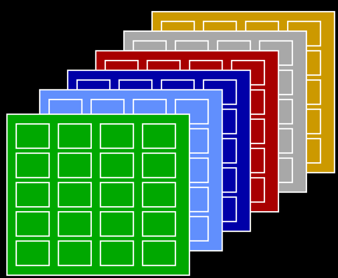
- Low tech, labor intensive industries
- Fashion and creative industries
- Large scale manufacturing industries
- Business and financial services

- “Anti-cluster clusters”



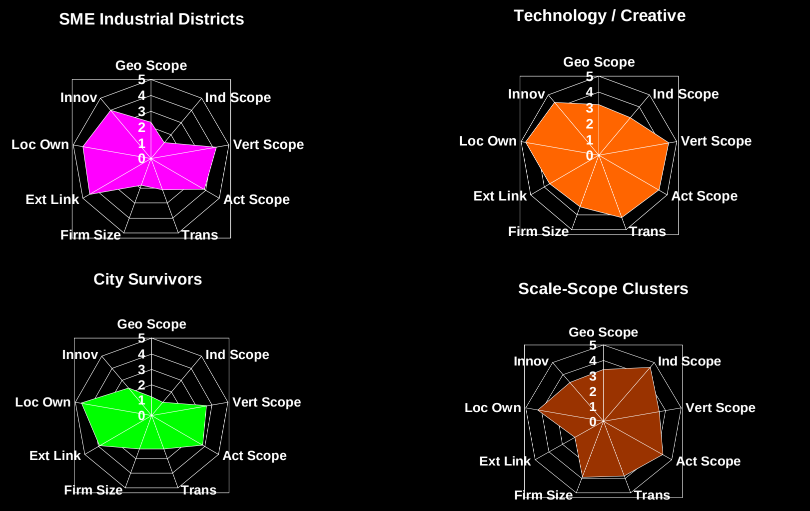
But we tend to forget clusters differ from each other in important dimensions

- Geographic scope
- Industry scope
- Vertical Scope
- Activity Scope
- Transaction governance
- Size of firms
- External linkages
- Local / foreign ownership
- Innovation performance

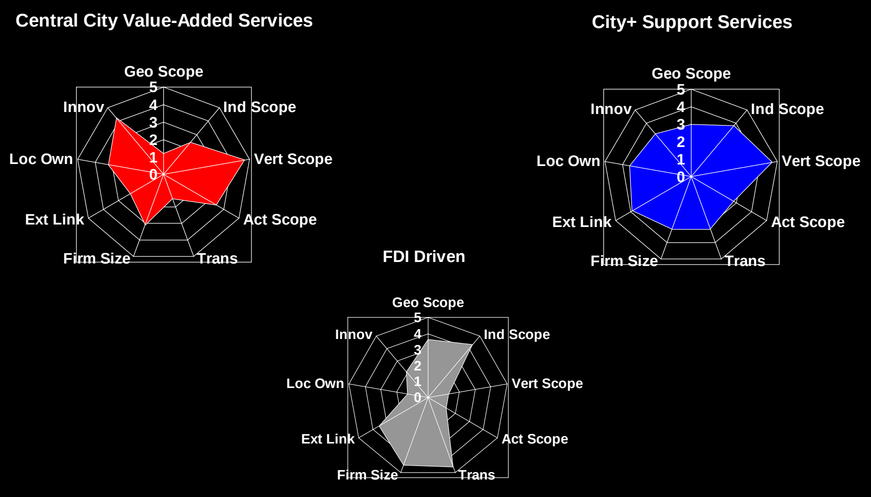


Variations on these dimensions yields a “family of clusters approach”

Cluster types (I)

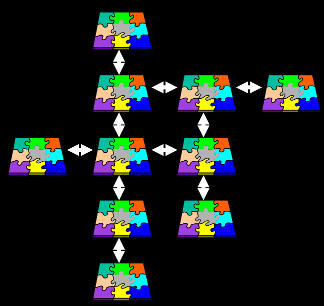


Cluster types (II)

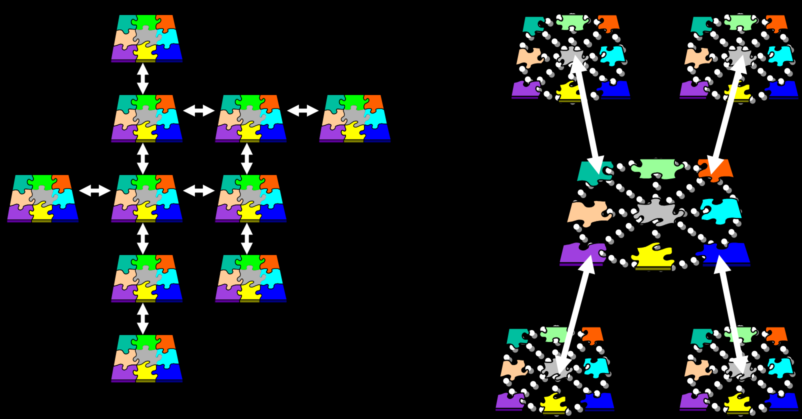


Industry and activity-based clusters

- Traditional view
  - All activities performed locally
  - Multiple vertical and horizontal linkages
  - Dense sets of local related entities
- East Asia has those but also has
  - Clusters that involve FDI
  - Clusters performing a single activity
  - Linkages to similar clusters
  - Regional production chains
- Activity-based clusters
  - Specialized mono-capabilities
  - Links to international actors
  - Logistics and information flows

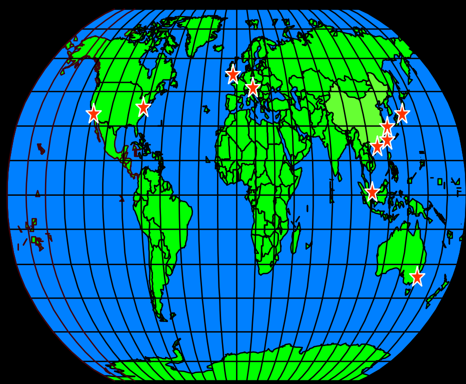


Localized and global-local clusters



Cluster nodes, networks, and the "mini-metanational"

- Networks of SMEs can be powerful
- Networks often need a central or coordinating entity and sufficient familiarity
- From "mini-multinational" to "mini-metanational"
- Often difficult for governments to promote or facilitate



Clustering and the creative economy

- What is going to continue to cluster in the face of globalization, improved communication, improved transportation, and globally networked strategies?
- Creativity, innovation, new knowledge?
  - Creation and innovation are interactive processes
  - Complementary skills and capabilities
  - Rapid information flows
  - Short feedback loops
  - Points toward direction of innovative efforts
  - Effectiveness of investments
  - Value of negative information
- Clusters as nodes of creativity, innovation, and knowledge

New directions and paradigms

- New forces are altering the “playing field”
- Will China clusters replace production clusters?
- Will India replace parts of service and tech clusters?

- “Families of clusters” approach allows distinctions
- “Activity-based” as well as “industry-based” clusters
- Global supply chains need clusters, but of new sorts

- Expand horizon of cluster thought and programs
- Address activity and industry-based advantages
- Need to externalize and internalize clusters

- SMEs need to run faster just to stay in place
- SMEs need to intensify linkages locally and globally
- New challenges for programs and policies

Thank you

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Fostering Regional Clusters

Professor Michael J. Enright
University of Hong Kong

APEC Symposium on Industrial Clustering for SMEs

March 2005

Fostering regional clusters

- There is a global search in process for the "magic bullet" solution to cluster development
- While much has been learned, the lessons often are misapplied
- Starting with a clear understanding of clusters and the purposes of cluster policy are necessary in order to create the right policies and programs
- While there is no single "magic bullet," there are guidelines that can be used that can help foster regional clusters
- Care must be taken to tailor specific programs and policies to the local context

Ensure sufficient understanding

- Of the local cluster base
  - Cluster identities
  - Cluster type
  - Cluster dimensions
  - Degree of realization
  - Competitive position
  - Innovative position
- Of the state of the art in the clusters
  - The relevant technologies and strategies
  - The competitors
- Of the local actors
  - Industry participants
  - Buyers, suppliers, related industries
  - Institutions

Goals and targets

- Goals
  - Should always be economic development goals
  - Intermediate outputs are not a substitute
  - Question of supporting clusters or clustering
- Target specific market failures
  - Provides a clear direction for programs
  - Use cluster-based groups to articulate demand for public services and involvement
- Market failures
  - Impacted information
  - Managerial myopia
  - Underprovision of public goods
  - Coordination failures

Program basics

- Provision of a sound business environment
- Basic and cluster-specific information and knowledge
- Basic and cluster-specific education and training
- Basic and cluster-specific infrastructure
- Business to business linkages
- Business to institution linkages
- Business to finance linkages
- Business to government linkages
- Articulation of demand for public services
- Cooperation on scale-sensitive downstream activities
- Cooperation on scale-sensitive upstream activities
- Cooperation on procurement
- Cooperation on benchmarking and horizon gazing

Choose role models carefully

- Similar cluster types
- Similar sets of actors
- Similar philosophies toward economic development
- Similar levels of technical capabilities
- Look at the basic roles played by different actors
- Match function rather than form
- Test against what is possible in the local environment
- Work around difficulties, shortcomings in the local environment
- Remember that one size does not fit all

Apply the right policies to the right types of clusters

- **City Value-Added**
  - ➡ Cluster-specific regulation
  - ➡ Advanced education
  - ➡ Overall business climate
  - ➡ Cluster-specific tax policies
  - ➡ Enhancing information flows
- **City+ Support**
  - ➡ Comm, trans infrastructure
  - ➡ Efficient public services
  - ➡ Business information provision
  - ➡ General business education
- **SME Industrial Districts**
  - ➡ Information provision
  - ➡ Cluster-specific infrastructure
  - ➡ Provision of services
  - ➡ Business linkage programs
  - ➡ Cluster-specific research/training
  - ➡ Community building

Apply the right policies to the right types of clusters

- **Technology / Creative**
  - ➡ General education
  - ➡ Regulatory system
  - ➡ Research support
  - ➡ General infrastructure
  - ➡ Cluster-specific skill building
- **City Survivors**
  - ➡ Overall infrastructure
- **Scale-Scope**
  - ➡ Tax policy
  - ➡ Specific infrastructure
  - ➡ Administrative efficiency
  - ➡ Subsidies or support
- **FDI Driven**
  - ➡ Investment promotion
  - ➡ General education, skill building
  - ➡ Basic infrastructure
  - ➡ Administrative efficiency

Program philosophy

- Clusters and regions differ
- Not every region can have every cluster
- Economic development goals are critical
- Performance is what matters
- Private sector involvement is key
- Government can help, but cannot replace firms
- Mechanisms to sustain momentum must be a main focal point right at the start
- Need to build support in the community
- Little victories are crucial to build momentum
- Focus on the easy things at first
- Question of government as catalyst or long-term actor

Need to iterate on program roles

- Of insiders
  - Business people
  - Policy makers at different levels
  - Institutions
  - Cluster organizations
  - Existing associations
- Of outsiders
  - Analysis
  - Information
  - Advice
  - Independent sounding board
- Importance of self-selection and group selection

Build evaluation in from the start

- Cannot do a complete job ex post
- Use the initial assessment to set the initial state
  - Performance of the cluster
  - Competitive position of the cluster
  - Linkages in the cluster
  - Level of interaction and realization
  - Understanding of technologies, competition, etc.
  - Presence of market failures
- Ex post evaluation on these dimensions
- Additional assessment based on what was learned in the process
- Builds in a goal orientation from the start
- Forces the right assessments from the start

Thank you

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APEC Symposium on Industrial Clustering for SMEs
Taipei, Chinese Taipei, March 8~9, 2005

Asia-Pacific Economic Cooperation

Clustering and Informatization of Women Enterprises

2005. 3. 28

Dr. Kio Chung Kim
Asian Pacific Women's Information Network Center (APWINC)
Sookmyung Women's University
Republic of Korea

APWINC

Contents

Asia-Pacific Economic Cooperation

- Key Issues for APEC
- Women's Enterprises: Current Status of Korea
- Government Initiatives
- Conditions for the formation of industrial cluster
  - Research, Capacity Building, Community, Forum
- APEC Project
  - Initiative for APEC Women's Participation in the Digital Economy
- Case Studies
  - Gyeonggi Women's Development Center
  - Asian Pacific Women's Information Network Center
- Recommendations for APEC

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Taipei, Chinese Taipei, March 8~9, 2005

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Key Issues

- Women are the resources of the Knowledge based Information Society, New Economy.
- E-Commerce is an essential tool
- ICT, e-Commerce, and Gender is the Keywords for APEC

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Women Enterprises : Current Status

- Korea Women enterprises represent 35.7% of the Total, 1,118,000 (2002 Korea National Statistical Office)
- 95.4% of women enterprises are micro-enterprises have fewer than 5 employees

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Women Enterprises: Current Status

Asia-Pacific Economic Cooperation

- Disproportionately grouped in a few sectors
  - Lodging and dining service (67.9% : gender ratio, KNSO 2002)
  - Educational service (57.3%), Manufacturing (15.7%)
- Startup business
  - Need to make a living (37.7%, SBDC 2003)
  - 30-40 ages 37.7%, High school graduates 50.3%
  - housewives 33.2%

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Women Enterprises: Current Status

Asia-Pacific Economic Cooperation

Associations of Small and Medium Business

- Korea Women Entrepreneurs Association (KWEA) www.womanbiz.or.kr
  - KWEA was founded by Law
- Korea Venture Business Women's Association (KOVWA) www.kovwa.or.kr
- Korea Women IT Enterprise Association (KIBWA) www.kibwa.or.kr
- Women Entrepreneurs Special Committee in Korea Federation on SMBs (ENSC-KFSMB) www.kfsmb.or.kr

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Women Enterprises: Current Status of Informatization

- **Informatization level is low for women entrepreneurs (Dec. 2002)**
  - **1.64 computers, 34.2% use a computer**
  - **4.25% Web sites**
  - **0.88% online transactions**
- Compare to female internet users
  - 45% (2002), 59.4% (2003), 67% (2004)

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Government Initiatives: support policies for women enterprises

- **Formation of a favorable environment to start business**
- **Identifying and nurturing promising industries**
  - **Training to foster e-Business professionals e-Lancers**
- **Expansion of domestic and overseas markets**
- **Preferential treatment**
  - **Government procurement**
- **Support Informatization by industries**
- Access to finance and training

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Government Initiatives:
Evaluation (sex- disaggregated data)

Current status of women enterprises will be surveyed in every other year by law

- Ministry of SMBA and KWEA

• 2002 survey results

Financial support (72%), Tax support (86%), Policies support market expansion (87%), Export assistance policies(89%), Informatization support Policies (85%)

Not aware more than (*%)

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Government Initiatives:
Ministry of SMBA Informatization Project

- $40 million budget, 2004
- Target small and medium businesses
  - More than 5 employees
  - Manufacturing industries
- Women enterprises fall through the net
  - 95% less than 5 employees
  - Service industries
- Benefited enterprises : only 6% are women enterprises
- 2005 Plan for informatization of women's business

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Obstacles

Asia-Pacific Economic Cooperation

- Lack of awareness of Government support policies, APEC activities
- Access to capital
- Social barriers, gender discrimination
- Access to Information
- Language barrier to foreign market

ONLINE

- No easy platform and tools
- Online security concerns, knowledge property right, data privacy

Formation of Industrial Cluster on E-Business

Asia-Pacific Economic Cooperation

- Cluster formation by region
- Cluster formation by industries
- Research, Capacity Building, Community, Forum

APEC Women's E-Biz Initiative

2005-2009

Ministry of Commerce, Industry and Energy of Korea

1. Research on e-Business (White Paper) of women enterprises in APEC
2. APEC Women's e-Biz Training
3. Building CyBizWorld
4. Forum on Digital Economy

- 10th ECSG (2004. 9)
  - 'Initiative for APEC Women's Participation in Digital Economy' was endorsed at 10th ECSG
- 9th WLN Meeting(2004. 10)
  - Fully support to 'Initiative for APEC Women's Participation in Digital Economy' was included in the recommendation of 9th APEC Women Leaders Network
- 16th APEC Joint Ministerial Meeting (2004. 11)
  - Recommendation to support 'Initiative for APEC Women's Participation on Digital Economy' was included in the Joint Statement at 16th APEC Ministerial Meeting

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Research on e-Business
(Jan. – Nov. 2005)

Asia-Pacific Economic Cooperation

To identify status and needs of APEC women enterprises
To publish white paper on e-Biz of women enterprises

Base Research

- Reviews the basic facts and environment about women's enterprises and e-Business in 21 APEC member economies by research template (template 1)

In-depth Research

- Looks into the details and specific issues about e-Business of women's enterprise focused on 8 economies, two from each four tier groups based on e-Readiness conducted by EIU (Economist Intelligence Unit Ranking), by research template (template 2)

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Research on e-Business
(Jan. – Nov. 2005)

Asia-Pacific Economic Cooperation

Procedures

- Research team, Advisory Committee, 21 Focal Points from WLN	March
- Primary research template (template 1) and detailed research template (template 2)	April
- Data collection	June
- Comparison, Analysis, Short Report	August
- Full report	October
- Publish books, CD, Circulation	November

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Research on e-Business

(Jan. – Nov. 2005)

Asia-Pacific Economic Cooperation

Primary Research : Template 1

- Current status on e-Business Infrastructure
- The actual condition of women-led business
- E-Business on women-owned business
- Supporting policies and programs related to e-Business of women's enterprise
- SWOT analysis

In-depth Research : Template 2

- Expected Target: U.S.A., Canada (or Australia), Chinese Taipei, Korea, Japan, Mexico, China, and Vietnam (or Malaysia, Thailand, Indonesia)
- On-Site Visit; Governmental Organizations, Women's business-related Organizations and Associations
- Case Studies

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APEC Women's e-Biz Training

(Jul. 18 ~ 29, 2005)

Asia-Pacific Economic Cooperation

To learn new technology and utilize e-business tools

To provide on- and off-line collaborative business opportunities

Participants	Program	Tool
-Women entrepreneur -Women enterprises association members -Young entrepreneurs -Policy makers	-Instructional Session; Special Session, Context Session, Skill Session Workshop -Field Trip	-Using CyBizWorld as a tool of e-Marketplace and e-Community

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Taipei, Chinese Taipei, March 8~9, 2005

APEC Women's e-Biz Training

(Jul. 18 ~ 29, 2005)

Procedures

- Training team, Trainers, Advisory Committee — March
- Preparatory Meeting with Trainers, Organizers — April
- Training curriculum — April
- Selection of participants — May, June
  (ITU: 10 policy makers as participants)
- Training Module and Program — June
- APEC Women's e-Biz Training — 18-29 July
- Evaluation — August
- Training Module CDs, Reports — August

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Taipei, Chinese Taipei, March 8~9, 2005

APEC Women's e-Biz Training

(Jul. 18 ~ 29, 2005)

Venue: Sookmyung Women's University, Seoul, Korea
Date: July 18-29, 2005

Hosted by APEC, Ministry of Commerce, Industry and Energy (MOCIE) of Korea
Organized by Asian Pacific Women's Information Network Center (APWINC)
Supported by ECSG, WLN, GFPN, ITU. UNESCAP, Women's Entrepreneurs Associations and Networks

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Taipei, Chinese Taipei, March 8~9, 2005

Building CyBiz World
(Jan. ~ Dec. 2005)

Asia-Pacific Economic Cooperation

To provide online community and simple e-Commerce tools
To provide mutual Business Cooperation by on-line

ASP Service System

- Providing EC, CRM, ERP, SEM Solution
- Developing Mall Wizard, Model for Standard Shopping Mall
- Supporting off-line e-Business System

Web Portal CyBizWorld

- Community site for APEC Women Enterprises
- Developing Contents, unique for APEC Women Enterprises
- Linking website of APEC Women Enterprises and on-line shopping mall

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Building CyBiz World
(Jan. ~ Dec. 2005)

Asia-Pacific Economic Cooperation

Procedures

- CyBizWorld team, Advisory Committee — Jan.
  Design of CyBizWorld — March
- Developing System (prototype) — June

- Educating the systems during APEC e-Biz Training
  July 18 ~ 29, 2005
- Running Service Model and feedback request
  Aug. ~ Dec. 2005

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Forum on Digital Economy for Women

Asia-Pacific Economic Cooperation

(Aug. 2005)

To enhance women's participation in the digital economy
To activate e-Business for APEC women's enterprises
To publish recommendations and report to APEC Foras and WSIS

Forum

- The tentative agenda includes presenting the research outputs and training results, and CyBizWorld from the previous three phases
- APEC and the government's role successful case studies,
- Strategies for e-business of women enterprises
- Strategies for women's participation in digital economy

Special Event

- Opening Ceremony of APEC Women E-Biz Center for this Initiative
- 10 minutes video script on e-Business to promote e-Business in APEC (Contains introduction of e-Business, best practice, APEC e-Business training, and future intended vision of e-Business)

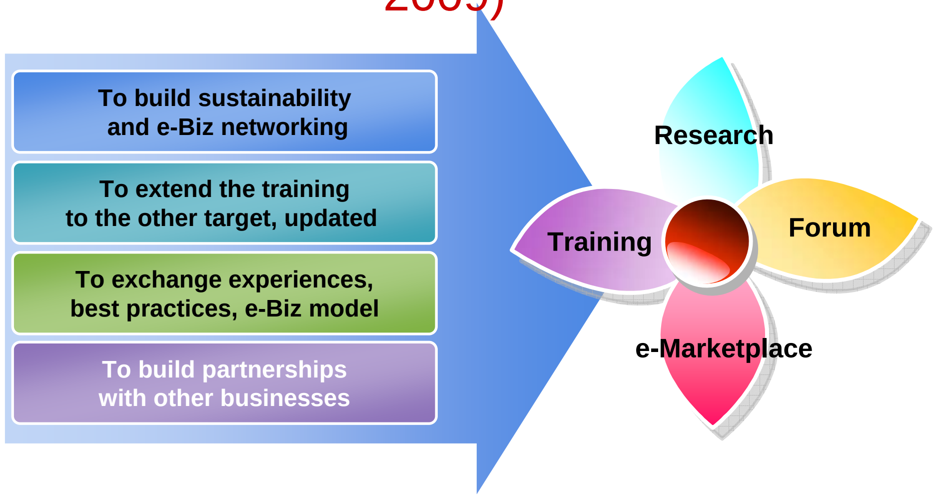
Forum on Digital Economy for Women

Asia-Pacific Economic Cooperation

(Aug. 2005)

- Venue: International Conference Hall, Sookmyung Women's University, Seoul, Korea
- Date : 28 – 29 August(not fixed), 2005 (WLN meeting : 24 – 27)
- Hosted by APEC, Ministry of Commerce, Industry and Energy (MOCIE) of Korea
- Organized by Asian Pacific Women's Information Network Center (APWINC)
- Supported by ECSG, WLN, GFPN, ITU. UNESCAP, Women's Entrepreneurs Associations and Networks
- Participants: academia, women, policy makers, and women CEOs, about 200
- The Forum will be held with related forums such as ECSG, SMB WG, GFPN, and TELWG and WLN

Follow-up Project (2006 - 2009)



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Taipei, Chinese Taipei, March 8~9, 2005

Best Practices

Asia-Pacific Economic Cooperation

- Case1: Gyeonggi Women’s Development Center
- Case 2: Asian Pacific Women’s Information Network Center

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Taipei, Chinese Taipei, March 8~9, 2005

Case 1: One Stop Business Incubator

Gyeonggi Women's Development Center(GWDC)

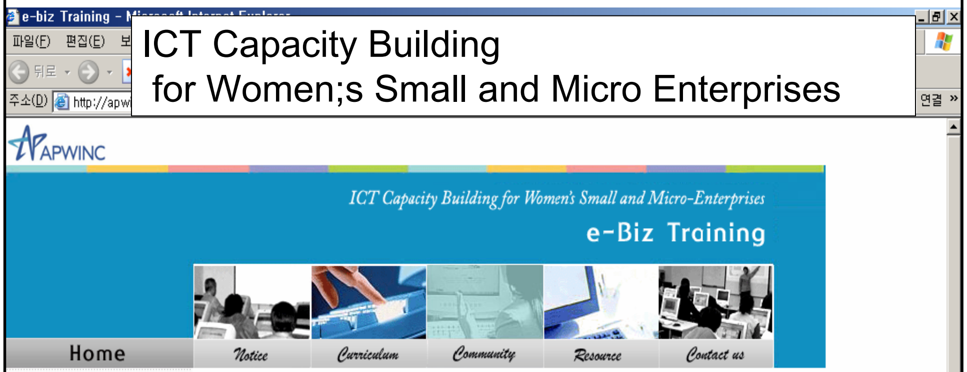
- Computer Facilities
- Consulting
- Mentoring
- Business Networking Services

Case 1: (GWDC) www.womenpro.or.kr

- Venture incubation of micro women's enterprises
- Specialized and customized IT education program
- Information network system,
- BizTalk Systematic collaboration-mentoring
- 14 Province based public Institutions such as GWDC in Korea

Case 2:
APEC Women's E-Biz Training
2004. 7.26 – 8.7 (APEC Education Foundation)

ICT Capacity Building
for Women;s Small and Micro Enterprises



Oraganized by APWINC
Partnership with BPW, UNESCAP, EduPACT, ITU
28 women CEOs from 13 APEC Economies

Recommendation to APEC

- **Builds up a network of micro and small business as a unit**
- Utilizing new technologies

  Value added Knowledge Services of Women's small and Micro enterprises
  - Online Security
  - Simplify the process of trading
  - Paperless trading
- APEC Trade Related Capacity Building
  - Training Module, Training workshop

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Recommendation to APEC

Asia-Pacific Economic Cooperation

- Customized Capacity Building on e-Commerce, m-Commerce
  - Contents: TRCB, Paperless Trade, etc.
- Networking and Partnership
  - Expands business and creates New collaborative business
- Sex-disaggregated Data on women enterprises
  - White paper

One Stop APEC women e-Business Center as a systematic and practical Channel

APWINC

Asia-Pacific Economic Cooperation

Thank you

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The Successful Factors for an Industry Cluster: The Experience of Hsinchu Science Park

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The Successful Factors for an Industry Cluster: The Experience of Hsinchu Science Park

I. Literature Review
II. The History of HSP
III. The Role of Government in Chinese Taipei Semiconductor Industry
IV. Innovations and Scale Economies
V. Conclusions

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Purpose

- The purpose of this paper is to review the development history of Hsinchu Science Park to examine the roles of the government.

Conclusions

- We conclude that the development of Chinese Taipei PC cluster was essentially entrepreneur-led, while the development of the IC cluster involved a strong role by the state, and it is the IC industry that drove the agglomeration with a geographical locus on HSP.
- We argue that scale economies and innovation are two key elements in the success of a high-tech cluster like HSP, but these two elements cannot be brought about by a government alone.

Literature Review

- Bresnathan, Gambardella, and Saxenian (2001) concluded that entrepreneurship, linkage to a growing market, and supply of skilled labor are three key ingredients to the successful starting of a high-tech cluster.
- The human connections to the high-tech community in Silicon Valley are considered to be the key impetus to HSP's emergence and growth, but the development of the cluster is essentially entrepreneur-led. (Saxenian & Hsu 2000; Saxenian 2002).
- The role of government is essential for providing the infrastructures and institutions that paved the foundation for HSP's success (Hobaday 1994; Mathews 1995; Amsden and Chu 2003).

5

The History of HSP

- HSP was established in 1980 by the Chinese Taipei government to boost the development of a high-tech industry.
- Generous fiscal incentives have been offered to enterprises located in the Park, including a five-year tax holiday on business income tax, exemption of tariffs on imported machinery and on imported materials, provided that the final goods produced out of these materials are exported, and a subsidized rent for land lease.
- It can be seen from the policy setting that the Park envisaged by the policy makers was something similar to an export processing zone, which provided exactly the same incentives in the 1960s.
- Unlike the export processing zones in the 1960s, HSP was not an immediate success. In fact, it was very slow to start.

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6

The History of HSP

- In the first ten years of HSP, personal computers and peripheral products dominated the Park. It was, in fact, existing companies such as Acer and Mitac that relocated into the Park, rather than new start-ups. These companies mainly served as subcontractors for international brands and they spent little on R&D.
- By the year 1990, there were 121 companies located in HSP with 22,356 employees and a total turnover of NT$65.6 billion. Computer and peripherals accounted for 56.5% of the sales value, but HSP was nothing but a congregation of subcontractors, which had little impact on the world’s high-tech industry.
- In 1993 the value of IC production and IC design surpassed that of computers and peripherals. In that year the total sales revenue of HSP reached NT$129.0 billion, almost doubling the value in 1990. Ten years later in 2003 the sales revenue of the Park reached NT$856.5 billion, a 7-fold increase in a decade.

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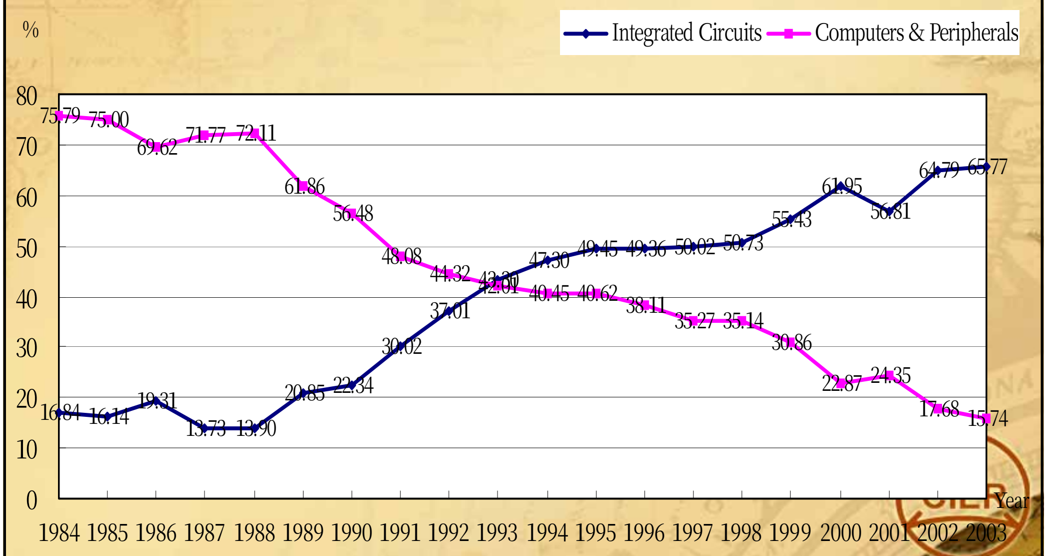
7

Percentages of sales of integrated circuits and computers and peripherals in Hsinchu Science Park



8

The Role of Government in Chinese Taipei Semiconductor Industry

- Chinese Taipei's semiconductor industry started with a government-sponsored project to transfer CMOS (complementary metal oxide semiconductor) technology from RCA in 1976. The project team was then spun off from Industrial Technology Research Institute (ITRI) to set up a semiconductor company named United Microelectronic Corporation (UMC), which established its first fabrication plant within HSP in 1982.
- Establishment of Chinese Taipei Semiconductor Manufacturing Corporation (TSMC) in 1987.
- The establishment of TSMC, which strategically decided to devote itself to foundry service without offering its own products, is the starting point of a visible agglomeration process in HSP.

The Role of Government in Chinese Taipei Semiconductor Industry

9

- Following TSMC, a group of 27 Chinese Taipei engineers returned from the U.S. to establish a new semiconductor company named Macronix in 1989.
- With the provision of foundry service by TSMC, which turned out to be first-class in the world, a flock of IC design houses was established after 1987. Some major design houses that excel today were established between 1987-1990, including SIS, Realtek, and Sunplus. In total, 37 design houses were established in this period.
- On the upstream side, the government established Taiwan Mask Corporation in 1988 to provide photo-masks for IC processing, saving the needs to outsource masking service from the U.S. A private mask-making company Hsin-Tai was established in 1991.

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The Role of Government in Chinese Taipei Semiconductor Industry

10

- The world's leading semiconductor equipment producer, Applied Materials, set up a subsidiary in HSP to provide hands-on service in 1993.
- Capping the stream of vertical integration was the establishment of Taisel in 1994 to provide polished and epitaxial wafers for IC fabrication.
- Following Taisel, two joint venture companies involving Japanese Shin-Etsu and Komatsu began to offer similar products in 1996 and 1999 respectively.

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11

Innovations and Scale Economies

- It is the foundry service model innovated by TSMC and later followed by UMC that created an important externality to drive the agglomeration process in HSP.
- With TSMC serving as a virtual “fab”, IC design houses save the need to invest in modern equipment which is often in the magnitude of billions of US dollars. TSMC also has helped them circumvent the IPR protection in the IC fabrication process. In return, TSMC is able to leverage the technologies of these innovation-oriented designers to advance its own technologies.
- The platform provided by TSMC and UMC allows Chinese Taipei engineers returning from Silicon Valley to put their knowledge and innovations to work with a small sum of investment, which is often rewarded with big returns in a very short span of time.

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12

Innovations and Scale Economies

- Proximity provides an important edge to design houses in HSP compared to their competitors in the U.S. Physical proximity is advantageous for innovative activities that involve highly complex technological knowledge and uncertainty, and require coordinated experimentation across functional and disciplinary boundaries.
- IC design houses are the most dynamic sector in Chinese Taipei’s semiconductor industry. In 2000, there were 140 IC design houses (57 located in HSP) compared to 16 IC manufacturers (15 located in HSP). Chinese Taipei ranked second only to the U.S. in terms of the output value of the IC design sector.

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13

Innovations and Scale Economies

- The key to success in chip design is a capacity to design differentiated performance features that meet the needs of the industry, in addition to being able to use leading-edge process technology to produce the low-cost devices containing these features. The most notable players developed out of HSP are the chip-set designers.
- Innovations have generated economic rents, which are not only accrued to entrepreneurs, but also to skilled workers.
- In December 2003, a total of 101,763 persons were employed in HSP, with an average age of 31.72 years, and 21.4% of them hold a master or Ph.D. degree.

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14

Conclusions

- In this paper we argue that scale economies and innovation are two key elements in the success of a high-tech cluster like Hsinchu Science Park. While scale economies are critical to the inauguration of a cluster, innovation is critical to the growth of a cluster.
- Scale economies provide a foundation for backward and forward linkages and for horizontal differentiation of products as well. The backward and forward linkages drive vertical integration that gives a competitive edge for firms located in geographically proximate areas. Horizontal differentiation provides rivalry and creates a competitive environment that is conducive to innovation.

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Conclusions

- The experience of HSP indicates that even if the linkage to a growing and major market like the U.S. is successful, there is no guarantee that the backward and forward integration will take place automatically. This is because there are always technological barriers and monopoly power associated with these barriers.
- In the case of HSP, linkages to the major markets were achieved by its innovation of a new business model whereby Chinese Taipeiese IC firms provide foundry service to the world's integrated device makers (IDM) and fabless design houses. This was the beginning of the agglomeration process in HSP.

Conclusions

- In the end, it is innovations that underlie the evolution of HSP from an imitator of Silicon Valley to a major partner of Silicon Valley. Because scale economies are manufacturing-based, most innovations in HSP are process technologies rather than product innovations. To implement these innovations, a large sum of capital investment is required and that has to be supported by a large scale of production. Therefore, scale provides the base for all innovations.
- We should not give too much credit to HSP's linkage to Silicon Valley's technology community for driving innovations. The ability to leverage foreign technology depends on local technological capability. As process technology is the core of innovations in HSP, this can hardly be transferred in piecemeal through an un-coordinated reverse "brain drain".

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17

Conclusions

- Chinese Taipei's government played an important role in the micro-management of HSP, in addition to macro-management. However, the government's role in creating scale economies is limited.
- Chinese Taipei's government was actively involved in innovations through state-sponsored research agencies such as ITRI and the Institute for Information Industry. Government-funded research projects have accounted for more than half of the nation's R&D until recent years, but the effectiveness of these research projects is often questioned by critics. Government-funded research projects serve more the purpose of training and skill accumulation than innovations.

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The Successful Factors for an Industry Cluster:
The Experience of Hsinchu Science Park

Although the success story of Hsinchu Science Park (HSP) as a high-tech cluster is well-known by now, the factors that contributed to its success are not quite clear. After studying the HSP case along with other successful clusters such as Cambridge of UK, Banglore of India, Bresnathan, Gambardella, and Saxenian (2001) concluded that entrepreneurship, linkage to a growing market, and supply of skilled labor are three key ingredients to the successful starting of a high-tech cluster. In other studies, the human connections to the high-tech community in Silicon Valley are considered to be the key impetus to Hsinchu's emergence and growth, but the development of the cluster is essentially entrepreneur-led. (Saxenian & Hsu 2000; Saxenian 2002). Other authors give credit to Chinese Taipei's government for providing the infrastructures and institutions that paved the foundation for HSP's success (Hobaday 1994; Mathews 1995; Amsden and Chu 2003). They imply a strong role of the state.

The purpose of this paper is to review the development history of HSP to examine the roles of the government. We conclude that the development of Chinese Taipei's PC cluster was essentially entrepreneur-led, while the development of the IC cluster involved a strong role by the state, and it is the IC industry that drove the agglomeration with a geographical locus on HSP. The government not only was involved in infrastructure building and the provision of key technologies to the IC industry, but was also involved in firm-building and market-building. We argue that scale economies and innovation are two key elements in the success of a high-tech cluster like HSP, but these two elements cannot be brought about by a government alone.

I. The History of HSP

HSP was established in 1980 by the Chinese Taipei government to boost the development of a high-tech industry in an effort to upgrade Chinese Taipei's industry from labor-intensive production. The Park was located in northern Hsinchu, about 70 kilometers from the capital city of Taipei, in a stretched area of tea plantations. It was apparently modeled after Silicon Valley in many aspects of land design: in that the ratio of building space on each unit of land was much more restrained compared to the rest of the country, in that more space was allowed between buildings, more green areas were reserved, and commercial billboards were prohibited. A bilingual high school was established in the Park to accommodate the children of engineers returning from Silicon Valley. Generous fiscal incentives have been offered to enterprises located in the Park, including a five-year tax holiday on business income tax, exemption of tariffs on imported machinery and on imported materials, provided that the final goods produced out of these materials are exported, and a subsidized rent for land lease. Standard buildings were also provided for small start-ups which were not big enough to invest in their own buildings.

It can be seen from the policy setting that the Park envisaged by the policy makers was something similar to an export processing zone, which provided exactly the same incentives in the 1960s. This means that the industry to be cultivated is export-oriented, and therefore trade protection measures had never been on policy-makers' mind. To signal its high-tech status, an upper limit of a 22% corporate income tax would be assessed on the companies located in HSP, instead of the regular 35% applied elsewhere, should the tax holiday expire.[1]

[1] The maximum marginal tax rate on corporate income was 35% at the time HSP was established, and it was later reduced to 30% and 25% successively. When the marginal tax was cut to 25%, the tax rate applied on HSP was brought in line with the rest of the economy, ending the preferential treatment. The tariff exemption on imported machinery was also repealed when a zero tariff was applied universally to any imported machinery that was unavailable in Taiwan.

Unlike the export processing zones in the 1960s, HSP was not an immediate success. In fact, it was very slow to start. The Park itself was not large to begin with, only 210 hectares were developed in the first-phase of operation, but it took almost 10 years to fill up the space. In contrast, the first export processing zone was filled up in the first year when it was inaugurated in Kaohsiung in 1966. An EPZ was something to accommodate the comparative advantage of Chinese Taipei at the time, i.e., labor-intensive production; HSP tried to create a comparative advantage that had not existed heretofore (Mathews 1995). In the first ten years of HSP, personal computers and peripheral products dominated the Park. It was, in fact, existing companies such as Acer and Mitac that relocated into the Park, rather than new start-ups. These companies mainly served as subcontractors for international brands and they spent little on R&D. The government also lured a US-based major computer terminal producer, WYSE, to the Park, but it was hardly a high-tech company and folded up in a few years.[2]

Innovations among these companies were limited and did not generate any visible “knowledge spillover” effects to characterize a high-tech cluster. The government jump-started a venture capital industry by providing tax incentives to venture-fund investors and chipped public money into several funds. However, all these efforts produced only a few start-up companies established by experts who had returned from Silicon Valley. One returnee-established company, named Microtek, did generate a mini-agglomeration effect in HSP. Established in 1984 by Dr. Bo-bo Wang, who previously worked for Xerox, Microtek developed the first computer-affiliated scanner in the world. The innovation attracted at least 20 other companies to join the industry, making Chinese Taipei the leading provider of scanners in the world.

[2] WYSE was acquired by the consortium of a Taiwan government investment fund and a group of private companies in 1989. WYSE was delisted in New York Stock Exchange and re-listed in Taipei Stock Exchange.

However, the technological edge of Chinese Taipei companies was not strong enough to protect their market leading positions. When major players in the field of image processing, such as HP and Cannon, joined the industry, Chinese Taipei producers quickly relinquished their market shares (Ma 1999). Scanner producers failed to produce the kind of agglomeration effects that HSP longed for, because the value of the products was small. In fact, major players like HP and Cannon waited until the market had grown to a profitable size and then intervened.

By the year 1990, there were 121 companies located in HSP with 22,356 employees and a total turnover of NT$65.6 billion. Computer and peripherals accounted for 56.5% of the sales value, but HSP was nothing but a congregation of subcontractors, which had little impact on the world's high-tech industry.

Things started to change miraculously when semiconductor manufacturing came into the scene and began to dominate the Park. In 1993 the value of IC production and IC design surpassed that of computers and peripherals (see Figure 1). In that year the total sales revenue of HSP reached NT$129.0 billion, almost doubling the value in 1990. Ten years later in 2003 the sales revenue of the Park reached NT$856.5 billion, a 7-fold increase in a decade. The number of companies operating in HSP also mushroomed from 150 in 1993 to 369 in 2003. The Park went through two phases of expansion during this period, enlarging the area of the Park to 632 hectares, and the expansion was halted only because the land in the adjacent regions was not available. More importantly, the impact of HSP on the world's high-tech industry was keenly felt, beginning in the mid-1990s. As a manifestation of this impact, when a 7.3 Richter-scale earthquake hit Chinese Taipei in September 1999, the spot price of semiconductor products shot up on the world markets immediately following the news.

Compared to the PC industry, in which the government kept its hands off the market most of the time except in the area of technology development, the government was deeply involved in the nurturing of Chinese Taipei’s semiconductor industry, including the grass-root firm-building and market-building. It is in the semiconductor industry that the agglomeration effect is most evident in HSP. In fact, today the majority of Chinese Taipei’s PC and peripheral firms are located outside the HSP, although they are in the corridor stretching from Taipei to Hsinchu. HSP can hardly take the credit for the agglomeration of Chinese Taipei’s PC industry. In contrast, HSP houses the mainstay of Chinese Taipei’s semiconductor manufacturers and IC design houses. In the following section we will describe the development and agglomeration process of Chinese Taipei’s semiconductor industry, whereby the role of the government will be discussed.

II. The Role of Government in Chinese Taipei’s Semiconductor Industry

Chinese Taipei’s semiconductor industry started with a government-sponsored project to transfer CMOS (complementary metal oxide semiconductor) technology from RCA in 1976. The project team was then spun off from Industrial Technology Research Institute (ITRI) to set up a semiconductor company named United Microelectronic Corporation (UMC), which established its first fabrication plant within HSP in 1982. UMC produced some niche, but low-end IC products such as electronic watches and telephone-use IC chips that entered the world market. In the same year, ITRI also spun off Chinese Taipei’s first IC design house, Syntek. Subsequently, two IC design houses, Mosel and Vitelic, were established in HSP by some Chinese Taipei engineers who had returned from Silicon Valley. Because of the lack of foundry capacity, they had to source foundry service from Japanese semiconductor manufacturers like Oki, while cooperating with ITRI in building up their design capabilities. Mosel successfully designed the 256K DRAM, but decided to sell the technology to Korea’s Hyundai instead of manufacturing it in Chinese Taipei.

The government soon realized the need for a major semiconductor manufacturing company in Chinese Taipei to provide foundry capacity. The result was the establishment of Taiwan Semiconductor Manufacturing Corporation (TSMC) in 1987. TSMC was intended to be a private company, but the government had to coerce some major private enterprises at the time to take stakes in the new venture. Although the government persuaded the Dutch company, Philips, to take a significant share (27.5%) in the company under very favorable terms, in the end the government was still the largest shareholder of TSMC. At the time of its inauguration, the government closed the experimental foundry at ITRI, whereby the ITRI team spun off another company, named Winbond, with the support of a private business conglomerate. This was the first time that a private investor voluntarily took a stake in IC manufacturing.

We consider the establishment of TSMC, which strategically decided to devote itself to foundry service without offering its own products, as the starting point of a visible agglomeration process in HSP. Following TSMC, a group of 27 Chinese Taipei engineers returned from the U.S. to establish a new semiconductor company named Macronix in 1989. The company was founded with the support of a government-sponsored venture fund, together with a group of private investors. Former Vice President of ITRI, Tinghua Hu, served as the chairman. Macronix was devoted to the production of non-volatile semiconductor devices such as Mask Rom and Flash EPROM.

With the provision of foundry service by TSMC, which turned out to be first-class in the world, a flock of IC design houses was established after 1987. Some major design houses that excel today were established between 1987-1990, including

SIS, Realtek, and Sunplus. In total, 37 design houses were established in this period.[3] The capital requirement for IC design houses is minimal, and with the foundry service in close proximity, they can offer the most innovative and competitive products. This is an obvious external benefit generated by TSMC. Seeing the success of TSMC as a foundry service provider, UMC also changed its strategy by spinning off its design department into an independent design house and became a foundry service provider itself. The rivalry between TSMC and UMC produced one of the most competitive foundry service industries in the world, allowing Chinese Taipei to dominate this business even up until today. Their race in the foundry capacity and processing technology produced a rapidly growing industry with advancing technologies. Along with the growing foundry capacity, assembly and testing companies also mushroomed. Companies like ASE and SPIL quickly became the world's leading IC assembly and testing firms.

On the upstream side, the government established Taiwan Mask Corporation in 1988 to provide photo-masks for IC processing, saving the needs to outsource masking service from the U.S. As the industry boomed, a private mask-making company Hsin-Tai was established in 1991. TSMC also established its own mask-making department in the same year. Some foreign affiliates of Dupont, Toppan joined the photo-mask industry much later in 1998. The world's leading semiconductor equipment producer, Applied Materials, set up a subsidiary in HSP to provide hands-on service in 1993. Capping the stream of vertical integration was the establishment of Taisel in 1994 to provide polished and epitaxial wafers for IC fabrication. Taisel was a joint venture between American MEMC and China Steel Corporation (owned by the Chinese Taipei government). Again the effort of the

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[3] There were 18 design houses at the end of 1986, and the number increased to 55 at the end of 1990. The sales revenue of IC design houses increased from 0.56 billion NT$ in 1986 to 5.9 billion NT$ in 1990.

government in driving a vertically-integrated industry was readable. Following Taisel, two joint venture companies involving Japanese Shin-Etsu and Komatsu began to offer similar products in 1996 and 1999 respectively. The Shin-Etsu subsidiary was located in HSP, while the Komatsu subsidiary was located in Yunlin county of central Chinese Taipei as HSP has already ran out of space then. The vertical integration of the semiconductor industry in HSP was by and large completed in the neighborhood of 1994-1995.

It has been 15 years since UMC was founded in 1980 to jump-start Chinese Taipei's IC industry, and the government's hands have been very visible in every step of the process. The government not only provided infrastructures, technology input, and fiscal incentives, it was also deeply involved in firm-building and market-building. The government went beyond "market augmentation" as described by Wade (1990) in the pre-1990 industrialization process. The government was effectively making a market. Two major pure private-owned semiconductor manufacturing companies, Powerchip and Nanya Technology were established in 1994 and 1995, respectively, to join the ranks of IC fabrication. Both concentrated on the production of DRAM: Powerchip serves as a subcontractor for Japanese clients like Renesas and Elpida, and Nanya Technology sells under its own brand. In 1995, the sales revenue of the semiconductor industry in HSP was NT$148.0 billion, which accounted for 49.5% of the total revenue in HSP. The sales revenue of the semiconductor industry grew to NT$563.3 billion in 2003, accounting for 74.5% of the total revenue growth in HSP during this period. It is quite clear that the chief engine for growth since 1995 was the IC industry although a prominent LCD industry began to emerge around the same time.

III. Innovations and Scale Economies

It is essential that some major innovations took place within a high-tech cluster to drive the agglomeration process. These innovations must have some externality effect in that they provided new opportunities for other business concerns, and that they created rents to attract new investment. In the Silicon Valley, innovations lead to innovations, which drive the agglomeration process. In the case of HSP, the technological depth was not enough to produce such a kind of positive cumulative effect. After all, it is only an imitation of Silicon Valley (Saxenian 2001) and imitations do not produce the kind of positive externality that genuine innovations like those in Silicon Valley do. A study conducted in 1993 (Ma 1996) indicated that HSP firms spent an average of 4.95% of sales on R&D, which was five times the national average, and 48.5% of the firms indicated that their major technologies were self-owned and self-created. The returning engineers from Silicon Valley provided the most important source for self-owned technologies. Another study showed HSP firms that obtained technologies from returning overseas engineers spent more on R&D rather than less (San 2004). This suggests that returning engineers increased the efficiency of R&D investment, because of their knowledge and management experience in technology companies and therefore this encourages the relevant firms to invest more on R&D. However, most innovations generated through local R&D or brought back by the engineers themselves are peripheral technologies, which only enhance the value of their products to strengthen the ties to Silicon Valley, but are unable to generate the kind of positive externality that drives the agglomeration process.

It is the foundry service model innovated by TSMC and later followed by UMC that created an important externality to drive the agglomeration process in HSP. The emergence of TSMC and UMC as capable foundry service providers forced the world’s semiconductor industry to play a different kind of game. Before the emergence of this service, the world's semiconductor production was ubiquitously vertically integrated with immense entry barriers embodied in technological and capital requirements. With the availability of a foundry service, the "fabless" design houses without their own factories were able to challenge the well-established integrated device makers (IDM) with their innovative products through TSMC.

With TSMC serving as a virtual "fab" for them, these design houses save the need to invest in modern equipment which is often in the magnitude of billions of US dollars. TSMC also has helped them circumvent the IPR protection in the IC fabrication process. In return, TSMC is able to leverage the technologies of these innovation-oriented designers to advance its own technologies. The platform provided by TSMC and UMC allows Chinese Taipei engineers returning from Silicon Valley to put their knowledge and innovations to work with a small sum of investment, which is often rewarded with big returns in a very short span of time. Many of Chinese Taipei's start-up design houses, such as Realtek, Sunplus, VIA, and Mediatek have enjoyed an enormous price-to-earning ratio after their stocks went public and the engineer-turned entrepreneurs became billionaires overnight. It is this "HSP dream" that induced the repatriation of seasoned engineers from Silicon Valley. In 2001, an estimated 4,292 engineers that came back from overseas were working in HSP (Jou 2004).

Proximity provides an important edge to design houses in HSP compared to their competitors in the U.S. As argued by Pavitt (1999; XI), physical proximity is advantageous for innovative activities that involve highly complex technological knowledge and uncertainty, and require coordinated experimentation across functional and disciplinary boundaries. Local design houses can work closely with the teams in TSMC and UMC to solve any technological problems involved in designing or manufacturing the products. The manufacturing knowledge of TSMC enables the design houses to design the products that can be fabricated in a most efficient way. It also provides verification and testing services that are key to the design of new functions. In return, the knowledge and newly-created functional objectives of the design houses have allowed TSMC to experiment with the frontier processing technologies. If clients allow it to experiment with new processing technologies, then TSMC is willing to undertake even a very small batch of orders (Hsu 2000).

IC design houses are the most dynamic sector in Chinese Taipei's semiconductor industry. In 2000, there were 140 IC design houses (57 located in HSP) compared to 16 IC manufacturers (15 located in HSP). Chinese Taipei ranked second only to the U.S. in terms of the output value of the IC design sector. In fact, there has been a boom of "fabless" design houses since 1990, not only in Chinese Taipei, but in the U.S. as well, driven by the widening technology gap between IC design capability and IC fabrication. While the productivity of IC fabrication has been increasing at a 58% compound annual growth rate over the past 20 years, the productivity of chip design has lagged behind (Ernst 2004). The gap opens up a great opportunity for start-up design houses to explore the advantages of IC fabrication technology and capacity, which luckily is located right here in HSP. Chinese Taipei's chip designers, like their counterparts in the U.S., focus on niche products; but they are blessed with proximity to the foundry service as well as lower labor costs.

The key to success in chip design is a capacity to design differentiated performance features that meet the needs of the industry, in addition to being able to use leading-edge process technology to produce the low-cost devices containing these features (Ernst 2003). In this regard, Chinese Taipei's vibrant PC industry provides a fertile ground for product differentiation. The most notable players developed out of this cozy environment are the chip-set designers. These designers take the CPU offered by Intel and other makers and complement it with auxiliary functions, embodied in logical and memory devices, to come up with a single chip which could be adopted by motherboard producers as a module to speed up the introduction of new-generation computers. Chipset makers serve as a specialized supplier in the vertical value chain linking the CPU makers with the computer makers. They have helped CPU makers like Intel and AMD to quickly transform a new CPU into a new fleet of computers. Because of their close interactions with CPU makers, they are able to access the latest technologies in Silicon Valley. Their role in the value chain is backed up by the formidable foundry service capacity available in HSP. Major chipset makers like VIA and SIS became important allies of Intel and AMD, thus benefiting from the innovations in Silicon Valley through this linkage.

Innovations have generated economic rents. Rents are not only accrued to entrepreneurs, but also to skilled workers. As a typical practice in HSP, invented by UMC and later followed by other firms, skilled workers are awarded with company shares at the end of each year in a profit-sharing scheme. The stock bonus helps bond the workers' loyalty to the company and rewards them for their contribution to the growth of the company. This encouraged skilled workers to devote extra efforts to the company that employs them. As a result, the most prominent engineering graduates from the nation's premier universities have flocked to HSP to work.[4] Although expatriate engineers played a key role in the early development of HSP, local graduates formed the mainstay of the R&D force in later years (Jou 2004). Without them, HSP could not grow to its current size. In December 2003, a total of 101,763 persons were employed in HSP, with an average age of 31.72 years, and 21.4% of them hold a master or Ph.D. degree. This must be one of the most educated labor forces in the world.

[4] A popular saying on Taiwan's university campuses in the 1960s and 1970s was "Come, Come, Come to Taita (NTU); Go, Go, Go to the U.S.A." Recently, this saying has changed to "Come, Come, Come to Tai-Tsing-Chiao (NTU, Tsinghua, and Chiaotung Universities); Go, Go, Go to Hsinchu." The saying reflects the popular trend of going to the U.S. for advanced studies of NTU students in the 1960s and 1970s, and that trend has changed to rushing to work in the Hsinchu Science Park after graduating from the nation's top universities.

As the agglomeration process in HSP is manufacturing-based, most innovations taking place in the Park are related to processing technologies. In 2003, Chinese Taipei firms were granted 6,676 patents by the U.S. patent office, making Chinese Taipei the fourth-ranked patent receiver there. The majority of these patents are semiconductor-related, and most of them are process technologies, TSMC and UMC being among the leading contributors of these patents. To make these process technologies work, Chinese Taipei IC manufactures spend a large proportion of sales revenue (sometimes over 100%) in new equipment investment year after year. This is only possible if their production is highly profitable. A "normal" return would not have been able to sustain this kind of capital investment.

Rapid capital accumulation did, however, lead to diminishing returns and the profitability of IC fabrication has declined drastically in recent years. In 2003 the rate of return on investment realized by Chinese Taipei's IC manufacturers (for the entire industry, including firms located outside of HSP) was only 6.9%. Conversely, the IC design industry continued its high-flying path of prosperity, manifested by a 40.2% return on investment in the same year (Shih 2004). The design industry is also characterized by rapid entry and exit, however.

The other important element in the agglomeration process is scale economies. A cluster must be able to grow both in terms of the size of the firm, and in terms of the number of the firms (Brensnaham et al 2001). Some firms in the cluster must grow to a commanding size before a backward or forward linkage can take place. This is particularly true when completing the vertical integration requires the participation of some innovative firms that possess significant monopoly power in the world market. A large number of small firms may not be powerful enough to prompt these suppliers or service providers to co-locate with them.

The experience of Chinese Taipei's computer industry is a case in point for the above example. Although Chinese Taipei had dominated the production of the world's personal computers by the end of the 1980s, no major semiconductor companies had ever decided to manufacture chips in Chinese Taipei to serve these "important" customers. Even the providers of CRT or flat panel displays did not care to locate a plant in Chinese Taipei. When Philips opened its first CRT plant in HSP in 1993 to provide 15'' tubes for Chinese Taipei's world-leading computer monitor industry, it was greeted with great enthusiasm. This happened only after one local producer, Chunghwa Picture Tube, had threatened Philip's market position and Philips had previously decided to relocate its TV production lines from Chinese Taipei to Mexico.

The agglomeration phenomenon suggests that firms cannot grow continuously without constantly enhancing their competitiveness, and enhancing competitiveness often has to be aided by some vertically-connected operations at a proximity to each other. Therefore, the development of a cluster is caught in a catch-21 situation if there are no major players in the industry. To break away from this dilemma, the government can give a helping hand. Some countries choose to provide resources to create "national champions" so that they can undertake vertical integration within the firm boundary. Chinese Taipei's government chose to invest in the vertically-related companies before the market conditions were mature. Therefore, it invested in Chinese Taipei Mask Corp., Taisel, and the like, to complete the vertical chain before private investors were willing to assume the risks. Had TSMC and UMC not grown to a commanding size in terms of their foundry capacity and therefore their non-negligible demand for semiconductor equipment, Applied Materials would not have set up a shop in HSP to provide hands-on service. When TSMC established one of the first 12-inch wafer fabrication lines in the Park to embark on the leading-edge wafer processing, Applied Materials had the chance to experiment with its newest equipment. The reputation of being adopted by TSMC with enviable yield rates allowed Applied Materials to sell the same equipment to TSMC's competitors.

A cluster must also grow in terms of the number of firms to facilitate the horizontal integration of the industry. Horizontal integration is important for two reasons. One is the provision of a local rivalry, and the other is the generation of a knowledge spillover effect in a closely-related technology field. Porter (1995) listed local rivalry as one important feature of a successful cluster. This does not mean international competition is irrelevant, but rather local competition brings a stronger impetus for progress.

Under similar environments and facing similar constraints, local rivals exert a stronger impact than international rivals. If TSMC is more profitable, then UMC will lose skilled workers to its neighbor due to more attractive stock bonuses offered by TSMC. If TSMC invested on a new-generation processing line, then UMC has to assess its impacts and best responses. Peer pressure amplifies competitive pressure within a cluster, even among non-competing firms. Difficulties arising from local competition provide no justification for government assistance. The rivalry between TSMC and UMC has prompted many innovations, not only in the technology field, but also in business models. When TSMC decided to switch its stock bonus scheme to American-style "stock options" recently, UMC defended its invented scheme and criticized TSMC openly.

The growth in the number of firms also means more variety of products that are offered in the same region. Aside from TSMC and UMC, which offer foundry service mostly for logic devices and serve a large pool of clients, there is Powerchip, which offers foundry service to memory devices, but for a small and exclusive group of clients. There is also Macronix which produces non-volatile memory products such as Mask ROMs. On the other hand, Nanya Technology produces DRAMs under its own brand and in 2003 entered a joint venture with Germany's Inferion to produce high-end memory products. Product differentiation provides the benefits of attenuating the business cycle that is notoriously severe in the semiconductor industry and gives some stability to employment in the HSP, a benefit of industry clustering which was recognized by Marshall (1890) long before.

As the industry has grown, there are an increasing number of specialized suppliers appearing in the Park. Some provide auxiliary service, which may not be critical to production, but nevertheless useful. For example, there are construction companies specialized in building clean rooms, laundry services that specialize in cleaning room robes and gears, and health clubs that make sure the high-tech staff stay fit.

Some scholars tend to attribute HSP's success to its linkage to Silicon Valley (e.g., Saxenian 2001, 2002). This linkage is important in terms of access to a growing market that provides the impetus for output growth in the cluster. The output growth, in turn, is essential to the division of labor within the cluster (Amsden 1976). Linkage is important for the creation of scale economies that help start a cluster, but it probably will not be strong enough to sustain the cluster, which requires localized technological capabilities. In the end, it is innovations that sustain the growth of HSP, and innovations are manifested in the IC design industry that is underlined by local technological capabilities. Beginning around 2000, a SoC (system-on-chip) design industry began to cluster in HSP, and this time, not caused by transfer of technologies from Silicon Valley, but by intrinsic local capabilities.

IV. Conclusions

In this paper we argue that scale economies and innovation are two key elements in the success of a high-tech cluster like Hsinchu Science Park. While scale economies are critical to the inauguration of a cluster, innovation is critical to the growth of a cluster. When HSP was first conceived, it was intended to be a high-tech park in the sense that most employees would engage in R&D work. The fact that HSP turned out to be a manufacturing-based high-tech park disappointed many “high-tech” minded people in Chinese Taipei. The reality is, if not for the manufacturing activities, HSP could not have gathered the kind of scale economies to set the agglomeration process in motion, because until today the intrinsic comparative advantage of Chinese Taipei still lies in manufacturing.

Scale economies provide a foundation for backward and forward linkages and for horizontal differentiation of products as well. The backward and forward linkages drive vertical integration that gives a competitive edge for firms located in geographically proximate areas. Horizontal differentiation provides rivalry and creates a competitive environment that is conducive to innovation. Since Chinese Taipei is a small economy, the domestic market cannot provide the kind of scale economies to engender the agglomeration process, and it has to link to some major external markets to realize such scale economies. This is why linkages to the growing IT market in the U.S. have played an important role in the take-off of HSP.

The experience of HSP indicates that even if the linkage to a growing and major market like the U.S. is successful, there is no guarantee that the backward and forward integration will take place automatically. This is because there are always technological barriers that prevent potential local firms from participating and benefiting from the advantage of vertical integration and because market power arising from the technological advantage allows foreign firms to feel comfortable to remain distant to the local industry. Chinese Taipei’s government always had to take the initiative in acquiring technologies and in establishing relevant companies to fill the slack in the vertical integration process. It is also important that some major players in the industry emerged from HSP to allow the late-coming cluster to leverage on the critical resources of an established cluster like Silicon Valley. Without such major players, the leverage would have been too weak to make HSP technologically sustainable.

In the case of HSP, linkages to the major markets were achieved by its innovation of a new business model whereby Chinese Taipei IC firms provide foundry service to the world's integrated device makers (IDM) and fabless design houses. The innovation has forced a new division of labor in the industry, from which Chinese Taipei firms found a strategic position in the value chain. This was the beginning of the agglomeration process in HSP. The innovation created two of the world's premier foundry service providers in HSP, attracting a fleet of "fabless" IC designers to locate in the Park to take advantage of the proximity to the foundries and their leading-edge process technologies. Although the co-location of assembly and testing facilities, photo-mask providers, and wafer suppliers is important in lowering the overall cost of the foundry service and in enhancing its flexibility of service, the interactions between foundries and design houses are the core source of positive externalities generated by proximity. As both process technologies and design capabilities are tacit knowledge, proximity provides the opportunity for them to reinforce each other and to create synergy. This environment produces some of the world's most prominent IC design houses, along with two premier foundry service providers.

In the end, it is innovations that underlie the evolution of HSP from an imitator of Silicon Valley to a major partner of Silicon Valley. Because scale economies are manufacturing-based, most innovations in HSP are process technologies rather than product innovations. To implement these innovations, a large sum of capital investment is required and that has to be supported by a large scale of production. Therefore, scale provides the base for all innovations. These innovations reinforce the capability of "fabless" design houses, which take this production advantage to create new features and new functions in IC chips. Although the innovations of these design houses are often peripheral and complementary with some fundamental technologies originating from Silicon Valley, they are able to success in the market due to their superior speed in terms of time-to-market, which is ultimately built on the readily accessible foundry capacity located in the neighborhood. The most dynamic and also most prosperous industry in HSP is IC design rather than IC manufacturing itself.

We should not give too much credit to HSP's linkage to Silicon Valley's technology community for driving innovations. One reason for HSP's ability to source from Silicon Valley for key technologies is the change of organization in global production in recent years. The reorganization of global IC production from a vertically-integrated, geographically-concentrated, closed system to a vertically-disintegrated, geographically-dispersed, open system forces the "flagship" companies in the global production system to share their knowledge more aggressively with distant network partners as they are under constant pressure to deliver the products faster and at lower costs (Ernst and Kim 2002). This provides opportunities for Chinese Taipei producers to leverage their knowledge with those in Silicon Valley. However, the ability to leverage depends on local technological capability. Although returning engineers from Silicon Valley were critical in transferring technologies to HSP in the early stage of its development, it is primarily local-educated engineers who have undertaken the mainstay of R&D activity in later years. As process technology is the core of innovations in HSP, this can hardly be transferred in piecemeal through an un-coordinated reverse "brain drain". When Chinese Taipei first transferred CMOS technology from RCA, it took a carefully coordinated transfer apparatus with wholehearted cooperation from RCA. This is not to deny that the linkage to the technology community in Silicon Valley is helpful, but to emphasize that linkage is not sufficient for innovations.

Chinese Taipei's government played an important role in the micro-management of HSP, as it was deeply involved in firm-building and market-building, in addition to macro-management in terms of providing infrastructure and environment. However, the government's role in creating scale economies is limited. No protective measures have ever been conceived to create a market for Chinese Taipei's budding IC industry. The penetration into the global market was mainly a private effort, although these private firms may have been created by the government. UMC chose to attack the niche markets that were largely ignored by major integrated device makers, and TSMC chose to offer a unique service to the industry. Unlike the strategy that the Chinese Taipei government undertook to develop the steel and petrochemical industries in the 1970s where market entry was controlled to ensure scale economies for "national champions", no entry restrictions have ever been imposed on the IC industry.

Chinese Taipei's government was actively involved in innovations through state-sponsored research agencies such as ITRI and the Institute for Information Industry (III). Government-funded research projects have accounted for more than half of the nation's R&D until recent years, but the effectiveness of these research projects is often questioned by critics. However, there have been many undisputed successful spin-off companies originating from government research projects, notably UMC and TSMC. This was a part of the firm-building process in which technology acquisition is a pre-requisite. Many research staff of ITRI and III left the government custody to establish or join private companies that gave new life to HSP. It suggests that government-funded research projects serve more the purpose of training and skill accumulation than innovations. Again, it is private enterprises that contribute critical inputs to innovations, not the government.

園區產業統計指標

Unit: NT$ Hundred Million

Year	Number of Companies	Number of Employees	Paid-in Capital	Sales
1981	17		7.2	N/A
1982	26		11.6	N/A
1983	37	3,583	19.6	30
1984	44	6,490	32.3	95
1985	50	6,670	40.6	105
1986	59	8,275	57.1	170
1987	77	12,201	105.6	275
1988	94	16,445	158.3	490
1989	105	19,071	282.2	559
1990	121	22,356	426.9	656
1991	137	23,297	551.1	777
1992	140	25,148	628.3	870
1993	150	28,416	668.9	1,290
1994	165	33,538	935.0	1,778
1995	180	42,257	1,477.0	2,992
1996	203	54,806	2,585.0	3,181
1997	245	68,410	3,756.5	3,997
1998	272	72,623	5,106.3	4,550
1999	292	82,822	5,660.2	6,509
2000	289	96,642	6,944.8	9,293
2001	312	96,293	8,588.2	6,625
2002	334	98,616	9,099.9	7,054
2003	369	101,763	9,924.5	8,578
2004	384	115,477	-	10,859

Growth of Combined Sales – by Industry

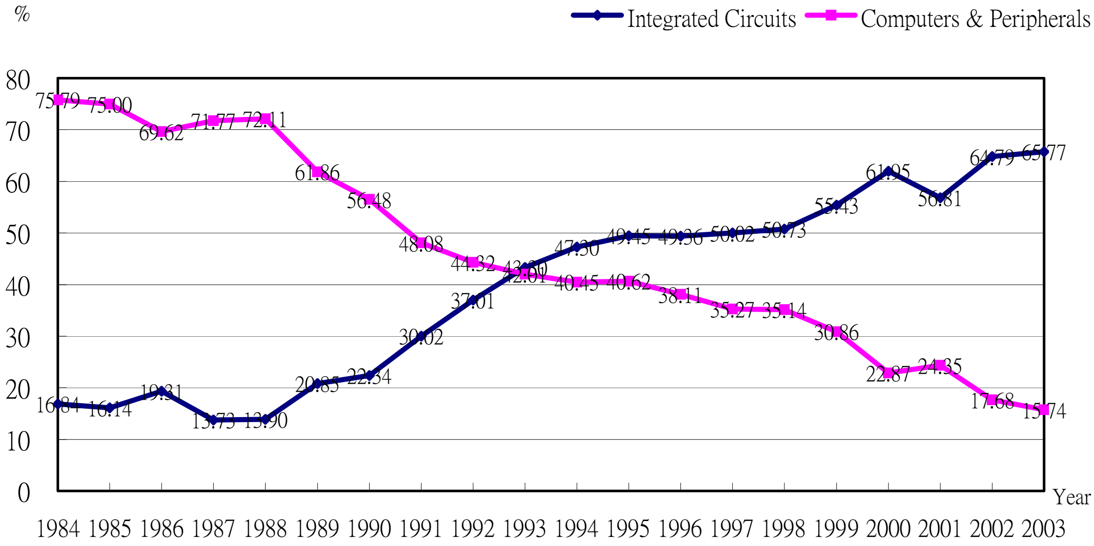
Unit: NT$ Hundred Million

Year	Industry						Sales
	Integrated Circuits	Computers & Peripherals	Telecom.	Opto-electronics	Precision Machinery & Materials	Bio-technology	
1981							
1982							
1983							
1984	16	72	5	0.7	1.3	0	95
1985	17	79	6	1.5	1.8	0.03	105.33
1986	32.91	118.66	9.65	6.05	2.72	0.44	170.43
1987	38.09	199.06	23.48	12.18	2.69	1.85	277.35
1988	68.08	353.26	45.00	15.99	3.00	4.53	489.86
1989	116.57	345.92	69.85	13.90	5.81	7.13	559.18
1990	146.49	370.34	113.60	11.43	8.18	5.58	655.65
1991	233.17	373.44	135.65	18.21	10.46	5.78	776.71
1992	322.14	385.71	124.48	20.18	13.28	4.59	870.38
1993	558.39	541.77	134.70	35.64	16.22	2.87	1,289.59
1994	840.85	719.08	147.29	47.24	19.46	3.72	1,777.64
1995	1,479.50	1,215.44	170.02	100.29	24.92	2.01	2,992.18
1996	1,570.53	1,212.37	192.63	175.34	27.68	2.47	3,181.47
1997	1,998.84	1,409.62	271.32	278.49	34.14	4.04	3,996.46
1998	2,308.29	1,598.94	264.48	297.60	75.02	5.69	4,550.02
1999	3,608.01	2,008.96	323.99	513.88	47.95	6.65	6,509.44
2000	5,757.11	2,124.89	507.70	809.22	72.58	11.34	9,292.65
2001	3,757.19	1,610.71	561.23	623.55	47.97	13.35	6,613.99
2002	4,562.59	1,245.28	565.58	600.35	53.89	14.16	7,041.88
2003	5,632.75	1,347.71	564.59	943.35	57.89	18.41	8,564.71

Figure 1

Percentages of sales of integrated circuits and computers and peripherals

in Hsinchu Science Park



Reference

Bresnathan, Timothy, Alfonso Gambardella and AnnaLee Saxenian, 2001, " 'Old Economy' Inputs for 'New Economy' Outcomes: Cluster Formation in the New Silicon Valleys," *Industrial and Corporate Change*, 10(4), 835-860.

Ernst, Dieter and Linsu Lim, 2002, "Global Production Networks, Knowledge Diffusion, and Local Capability Formation," *Research Policy*, 31, 1417-1429.

Ernst, Dieter, 2003, "Internationalization of Innovation: Why is Chip Design Moving to Asia?" *East-West Center Working Papers,* Economics Series, No.64.

Ernst, Dieter, 2004, "Late Innovation Strategies in Asian Electronics Industries: A Conceptual Framework and Illustrative Evidence," *East-West Center Working Papers*, Economics Series, No.66.

Hsu, Ching-Yu, 2000, "廠商的時空策略與動態學習：新竹科學園區積體電路工業爲例" (The Spatial Strategy and Dynamic Learning: The Case of IC Industry in Hsinchu Science Park), *Cities and Design (城市與設計學報)*, March 2000 (No.11/12), 67-96.

Jou, Su-Ching, 2004, "Cluster and Labor Force Dynamics: Human Resources and Structural Change of the Labor Force in the HSP," unpublished project report, Chung-Hua Institution for Economic Research.

Koh, Francis, Winston Koh, and Feichin Ted Tschang, 2003, "An Analytical Framework for Science Parks and Technology Districts with An Application to Singapore," *Singapore Management University working paper*, No.18.

Ma, Wei-Yang, 1996, "新竹科學園區科技產業發展績效評估" (An Assessment of Hi-tech Industry Development in Hsinchu Science Park), *台灣經濟金融月刊*, October 1996, 36-47.

Ma, Wei-Yang, 1999, "從產業經濟觀點看新竹科學園區的發展－兼論台灣高科技

產業的環境” (The Development of Hsinchu Science Park from the Viewpoint of Industrial Economics), *Taipei Bank Monthly*, 29(6), 193-213.

Mathews, John, 1997, “A Silicon Valley of the East: Creating Taiwan’s Semiconductor Industry,” *California Management Review*, 39(4), Summer, 26-54.

Pavitt, K., 1999, *Technology, Management and Systems of Innovation*, Cheltenham: Edward Elgar.

Porter, Michael, 1998, “Clusters and New Economics of Competition,” *Harvard Business Review*, 76(6), 77-90.

Saxenian, AnnaLee and Jinn-Yuh Hsu, 2001, “The Silicon Valley-Hsinchu Connection: Technical Communities and Industrial Upgrading,” *Industrial and Corporate Change*, 10(4), 893-920.

Saxenian, AnnaLee, 2001, “Taiwan’s Hsinchu Region: Imitator and Partner for Silicon Valley,” Stanford University, Stanford Institute for Policy Research, working paper, No.00-44.

Saxenian, Anna Lee, 2002, “Transnational Communities and the Evolution of Global Production Networks: The Case of Taiwan, China, and India,” *Industry and Innovation*, 9(3), 183-203.

Shih, Chin-Tai, 2004, “從我國三兆產業之發展看我國電子資訊產業未來競爭力之挑戰” (The Challenges to the Competitiveness of Taiwan’s Electronics Industry: Examining the Development of Tri-trillion Industries), memo.

Pathways to innovation in Asia's leading electronics exporting countries – a framework for exploring drivers and policy implications

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Abstract: This paper offers a framework for exploring emerging pathways to innovation in Asian electronics industries, as well as their drivers and policy implications. The focus is on 'stylised facts' rather than on the diversity of specific country trajectories. I demonstrate that the role of Asia's leading players in the electronics industry is changing – from global export production bases for hardware and software, a transition is under way to the creation of commercially viable innovations and standards. I argue that transformations in global markets, production and innovation systems are providing new opportunities for Asian firms that seek to improve their innovative capabilities. To exploit these opportunities, however, important changes are required in Asia's innovation strategies, policies and management approaches. I highlight the considerable potential of 'technology diversification' strategies as an intermediate option for attempts to move beyond 'fast-follower' strategies.

Keywords: innovation; knowledge diffusion; global production networks; multinational corporations; innovation strategy; technology diversification: Asia; electronics industry; electronic design.

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Biographical notes: PLEASE SUPPLY BRIEF CAREER HISTORY (APPROXIMATELY 100 WORDS)

1 Introduction

Innovation is widely acknowledged to be a major source of economic growth [1]. In advanced nations, both governments and companies look at innovation as a *strategic weapon* to benefit from globalisation, and to survive its competitive pressures. However, in Asia (outside of Japan), *imitation* rather than *innovation* used to be the main focus of development strategies [2]. Catching-up with manufacturing capabilities of advanced nations and out-foxing them by becoming faster and lower-cost followers have been the dominant objectives [3].

These strategies have produced impressive results. The emergence of East Asia as a global export-manufacturing base during the last decades of the late 20th century is one of the few success stories of Third World industrialisation. In IT hardware manufacturing for instance, five Asian countries (China, Korea, Taiwan, Singapore and Malaysia) account for over one quarter of world production. Furthermore, while India has failed to excel as a global manufacturing exporter, the country has firmly established itself as a global export production base for software and information services.

Over the last few years, something new seems to have happened [4]. In the midst of a global downturn in IT industries, Asia's leading electronics exporting countries are all attempting to move beyond imitation. They appear to have seized upon new opportunities to create commercially successful innovations in the production of hardware, software, and services. These attempts to enter the global "innovation arms race" [5] may well have significant implications for the region's position in the global economy as well as for the possibilities and limitations of its development strategies. These developments are poorly understood and under-researched. We thus need to take stock of what is really happening. As a first step towards a theory of late innovation strategies, this paper offers a framework for exploring emerging pathways to innovation in Asian electronics industries, as well as their drivers and policy implications. The focus is on 'stylised facts' rather than on the diversity of specific country trajectories [6].

I demonstrate that the role of Asia's leading players in the electronics industry is changing – from global export production bases for hardware and software, a transition is under way to the creation of commercially viable innovations and standards. I argue that transformations in global markets, production and innovation systems are providing new opportunities for Asian firms that seek to improve their innovative capabilities. To exploit these opportunities, however, important changes are required in Asia's innovation strategies, policies and management approaches. I highlight the considerable potential of 'technology diversification' strategies as an intermediate option for attempts to move beyond 'fast-follower' strategies.

2 Pathways to innovation

Three important new developments characterise the emerging pathways to innovation in Asian IT industries:

1 Global firms are expanding and upgrading their R&D centres in Asia.

2 Leading Asian firms are emerging as new sources of innovation and global standards.

3 This may create new opportunities for smaller Asian firms (the 'new technology-based firms' or NTBFs) to enter diverse innovation networks as specialised suppliers.

Most of the literature on R&D internationalisation has focused on the relocation of R&D among industrialised countries [7]. However, global corporations have substantially increased their R&D in emerging economies, primarily in the above leading Asian electronics exporting countries [8]. This is especially the case in the electronics industry, due to its heavy exposure to three characteristics of the 'global networks economy' that I will describe in part two of this paper: vertical specialisation, global network integration, and the use of IT-based information management. Global corporations in the electronics industry (the 'network flagships') increasingly rely on international knowledge sourcing to manage their geographically dispersed global production, distribution and innovation networks [9]. The network flagships relocate R&D to locations with lower cost of knowledge-workers. Equally important is proximity to higher-end specialised network suppliers of components, manufacturing services and knowledge-intensive business services, especially design and engineering support services.

The main carriers of relocating R&D to lower-cost locations in Asia are global brand leaders (e.g. Intel), as well as global higher-tier suppliers, such as manufacturing and design service providers like Flextronics or HonHai or specialised global suppliers of 'silicon intellectual property' (SIP), like ARM. All of these firms are currently expanding and upgrading their R&D centres in Asia. They are also outsourcing R&D activities (mostly 'blue-collar' design and engineering implementation) to specialised Asian R&D suppliers. Primary locations for such R&D centres and for the outsourcing of R&D are China, India, Taiwan, Korea and Singapore. But the redeployment of R&D centres by global corporations now also covers specialised clusters in lower-tier countries like Malaysia, Thailand, Philippines, Indonesia, and Vietnam.

A second important new development is that leading firms from China, India, Korea, Taiwan and Singapore are emerging as potential new sources of innovation and global standards in sectors like electronic components (especially semiconductors and chip design), digital consumer devices, wireless telecommunication systems, and business process software. Again, a few illustrative examples should highlight the potentially far-reaching implications.

Chip design, a process that creates the greatest value in the electronics industry, has recently experienced a massive geographic dispersion to East Asia (Table 1). Excluding Japan, the region's share in the global production of chip designs is projected to grow from around 30% in 2002 to more than 50% in 2008 [10]. Taiwan has emerged as a primary new location for chip design: five of the top 20 world market leaders are from Taiwan. Korea is following closely behind, with the chip design departments of Samsung, SK Telecom, KT, LG Telecom as the main drivers. The creation of commercial chip designs is also rapidly growing in China and Singapore.

Table 1 Chip design moves to Asia

	1995	*2002*	*2008 (E)*
US share in global production of chip design (%)	78	60	18
Asia's share in global production of chip design (%)	< 4	30	> 50

Note: Asia = Taiwan, South Korea, India, China, Singapore, Malaysia

Source: iSuppli report on IC design, March 2003

Patents, a widely used proxy for innovative capabilities, also indicate substantial progress. Among patents granted in the USA, Taiwan did not show up in 1990 among the ten top countries. Ten years later, in 2000, Taiwan was ranked fourth (with 4,667 patents granted by the US Patent and Trademark Office), ahead of France and the UK, and Korea was # 8, ahead of Italy, Sweden and Switzerland (Table 2).

Table 2 Country ranking of patents granted in 1990 to 2000

Rank/year	*1990*	*1995*	*2000*
1	US (47,390)	US (55,739)	US (85,072)
2	Japan (19,525)	Japan (21,764)	Japan (31,296)
3	Germany (7,614)	Germany (6,600)	Germany (10,234)
4	France (2,866)	France (2,821)	*Taiwan (4,667)*
5	UK (2,789)	UK (2,478)	France (3,819)
6	Canada (1,859)	Canada (2,104)	UK (3,667)
7	Switzerland (1,284)	*Taiwan (1,620)*	Canada (3,419)
8	Italy (1,259)	*South Korea (1,161)*	*South Korea (3,314)*
9	Netherlands (960)	Italy (1,078)	Italy (1,714)
10	Sweden (768)	Switzerland (1,056)	Sweden (1,577)
11	*Taiwan (732)*	Sweden (806)	Switzerland (1,322)

Source: US patent and trademark office, January 2002

In digital consumer devices and mobile communications systems, serious efforts have been made to upgrade *system development* and *standard-setting capabilities*, especially in ‘Greater China’ (including Taiwan and Hong Kong) and in Korea. For instance, in *consumer electronics*, there are joint efforts by China and Taiwan to develop a new video-disk technology format, called EVD (enhanced versatile disk) that would allow resolution five times higher than the current *de facto* industry standard DVD, while helping China’s consumer electronics industry to escape full royalty payments to the dominant DVD licensing groups. Beijing E-World Technology, a consortium of ten Chinese DVD manufacturers, is conducting government-sponsored research, in collaboration with Taiwan’s Industrial Technology Research Institute (ITRI), and Taiwanese disk makers and chip design houses.

In *telecommunications*, Korea’s afore-mentioned four leading players are all engaged in serious efforts to become major platform and contents developers for complex technology systems, especially in mobile communications. These efforts can build on considerable capabilities, accumulated in public research labs (like ETRI, the Electronics and Telecommunications Research Institute), as well as in R&D labs of the chaebol, to develop complex technology systems like TDX (a switching system) and communication systems that are based on the CDMA (= code-division multiple access) standard.

Another important example is China’s attempt to develop an alternative third generation (3G) digital wireless standard, called TD-SCDMA (time-division synchronous code-division multiple access), for which it received approval by the International Telecommunications Union (ITU) in August 2000. The two dominant competing global 3G standards are W-CDMA (compatible with existing GSM operations, and supported by European firms), and CDMA 2000 (compatible with existing CDMA operations, and supported by US firms). The TD-SCDMA standard was developed by Datang Telecom, a Chinese state-owned enterprise and the Research Institute of the Ministry of Information Industry with technical assistance from Siemens. To accelerate the implementation of this strategy, Datang has formed a series of collaborative agreements: a joint venture with Nokia, Texas Instruments, the Korean LG group, and Taiwanese ODM (= original design manufacturing) suppliers, a joint venture with Philips and Samsung, and a licensing agreement with STMicroelectronics that will provide the Chinese company with access to critical design building blocks. Such linkages illustrate how integration into global production networks may facilitate Asian attempts to create commercially successful innovations (see Part 2).

Of course no serious observer would claim that China, Korea, Taiwan, and Singapore will soon overtake the USA, Europe and Japan as the global leading centres of innovation. Indeed, there is ample evidence that the sources of innovation remain highly concentrated. Of global R&D, 86% takes place in industrialised countries, with the US occupying the leading position with 37% [11]. For instance, the R&D budget of a US industry leader, Microsoft, at around $ 6.2 billion (for 2003), exceeds China's total R&D budget. The USA has raced ahead in the most prized areas of technological innovation, as far as these can be measured by patent statistics. The US 'innovation score' measures the number of patents granted by the US Patent Office, multiplied by an index that indicates the value of these patents [12]. Since 1985, the US 'innovation score' has more than doubled, a rate far better than any other country [13]. In 2002, all 15 leading companies with the best record on patent citations were based in the USA, with nine of them in the IT sector.

However, while the capability to produce innovations remains highly unequally distributed, there are clear signs that Asia's leading electronics exporting countries are *gradually* strengthening their position in the international division of knowledge creation. In a handful of emerging centres of excellence in Asia, sophisticated innovation and research capabilities appear to have followed the earlier development of electronics manufacturing capabilities.

3 Global transformations and the mobility of knowledge

The new push into cutting-edge research and innovation in our sample countries may actually be less surprising than it may look at first sight. It reflects the new mobility of knowledge through vertical specialisation into global production and innovation networks, which in turn may provide new opportunities for 'late innovation' strategies. Late innovators have easier access to international knowledge sources, due to four recent transformations in the global innovation system that encompass the "global network economy" [14]:

1 Global flagship networks integrate geographically dispersed production, distribution and innovation bases.

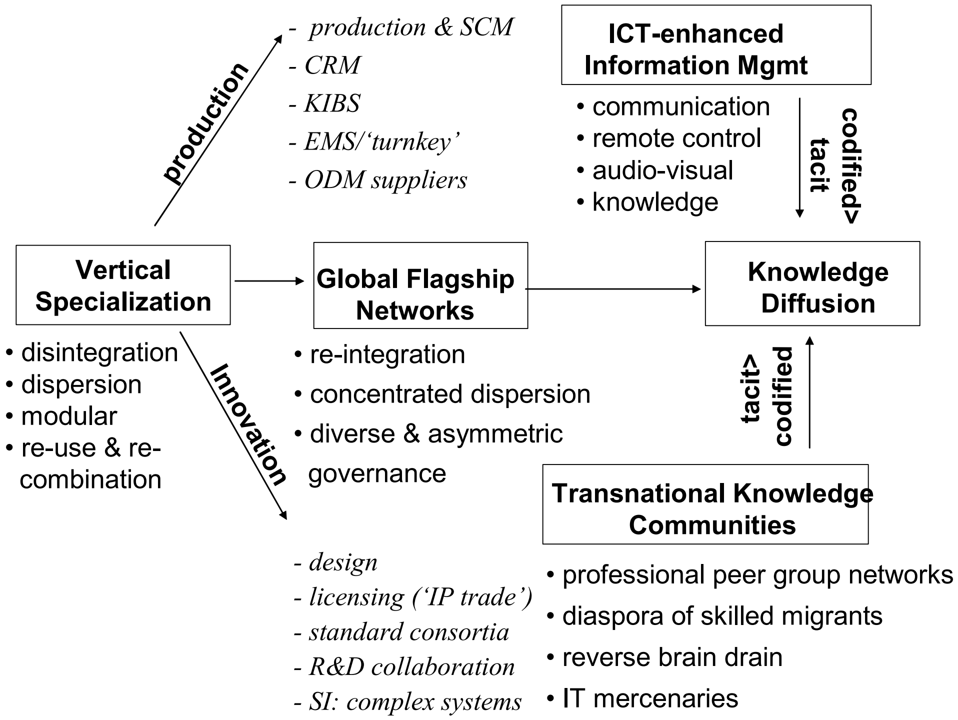
2 Global firms outsource R&D to locations with lower costs of knowledge workers.

3 Brain drain has produced transnational knowledge communities that can act as highly effective carriers of tacit knowledge.

4 ICT-enhanced information management can improve the coordination of these diverse networks.

Figure 1 provides a stylised model of how *vertical specialisation* (i.e. the disintegration of firm organisation and the geographic dispersion across national boundaries) and *re-integration* of dispersed production, distribution and innovation bases into hierarchical *global flagship networks* facilitate *knowledge diffusion*. Figure 1 also demonstrates the role played by two complementary enabling forces in enhancing both codified and tacit knowledge exchange: *ICT-enhanced information management* and *transnational knowledge communities*.

Figure 1 Vertical specialisation, GFNs and knowledge diffusion



Let us first look at the latter two enabling factors. In all Asian countries, but especially in China, earlier 'brain drain' has produced overseas communities of engineers, scholars, and managers who are familiar with cutting-edge technology and best-practise management approaches and who understand the dynamics of international product and financial markets. These transnational knowledge communities can play an important catalytic role in the development of domestic innovative capabilities [15].

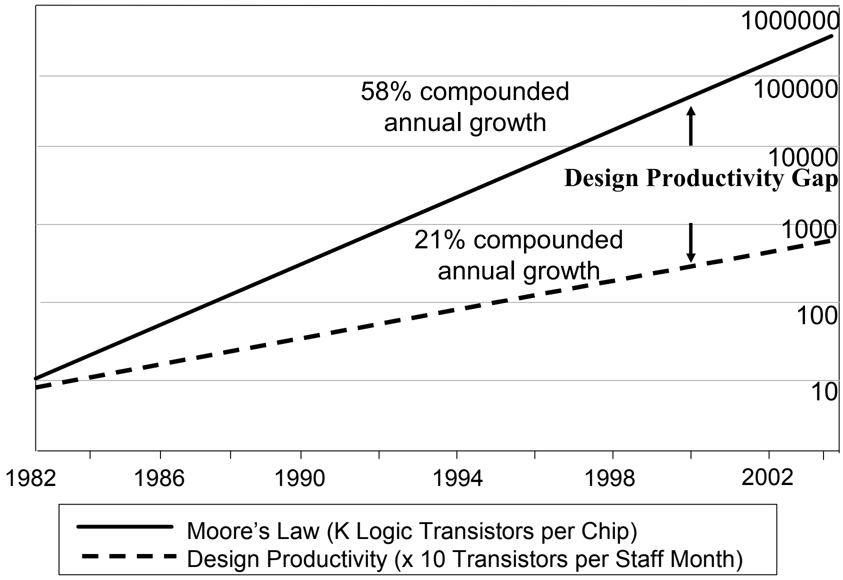
The use of ICT as a management tool can enhance the scope for knowledge-sharing among multiple network participants at distant locations [9]. But these changes will occur only gradually, as a long-term, iterative learning process, based on research and experimentation. The digitisation of knowledge implies that it can be delivered as a service and built around open standards. This has fostered the specialisation of knowledge creation, giving rise to a process of modularisation, very much like earlier modularisation processes in hardware manufacturing. As a result, one of the most important recent developments that affect international knowledge diffusion is the rapidly growing trade in intellectual property rights (IPR), especially for chip design [16].

Under the heading of 'e-business', a new generation of networking software provides a greater variety of tools for representing knowledge, including low-cost audio-visual representations [17]. Those programs also provide flexible information systems that support not only information exchange among dispersed network nodes, but also the sharing, utilisation, and creation of knowledge among multiple network participants at remote locations [18]. New forms of remote control are emerging for manufacturing processes, quality, supply chains, and customer relations. Equally important are new opportunities for the joint production across distant locations of knowledge support services (e.g., software engineering and development, business process outsourcing, maintenance and support of information systems, as well as skill transfer and training). While much of this is still at an early stage of 'trial-and-error', global network flagships in the electronics industry now face a huge potential for extending knowledge exchange across organisational and national boundaries. However, the uncertainties and complexities of operating in global markets means that there are agglomeration economies to be derived from dense spatial concentrations of specialised network suppliers. Hence, new opportunities emerge for pathways to innovation in Asian electronics industries.

'Vertical specialisation' (or 'outsourcing' in common parlance) is no longer restricted to the production of goods and services but now extends to all stages of the value chain, including research and new product development. This may facilitate the implementation of 'late innovation' strategies in leading Asian electronics exporting countries. Take chip design [19]. Until the mid-1980s, captive semiconductor producers (like IBM) and merchant firms (like Intel) did almost all their chip design in-house. The first step of vertical specialisation was the separation of fabrication and design. The emergence of independent providers of pure-play 'silicon foundry' services gave rise to a proliferation of 'fabless' design houses (like Altera) that focused on specific niche markets for integrated circuits.

Over time, a second stage of vertical specialisation has occurred *within* the process of chip design itself. A primary driver has been a widening productivity gap between design and fabrication. While the productivity of semiconductor fabrication over the last 20 years has seen a 58% compounded annual growth, the productivity of chip design has lagged behind, with only a 21% compounded annual rate (Figure 2). Given this design productivity gap, differences in the cost of employing a chip design engineer have become an important determinant for decisions on where to locate chip design. In light of the fact that the annual cost of employing a chip design engineer in East Asia is between 10 and 20% of the cost in Silicon Valley (Table 3), it is hardly surprising to find that chip design is being relocated to leading electronics clusters in East Asia that provide a skilled and re-trainable workforce as well as easy access to foundry, assembly and testing services.

Figure 2 Widening design productivity gap in integrated circuits



Source: *International Technology Roadmap for Semiconductors 2002 Edition*, 2002, Semiconductor Industry Association, Austin, Texas

Table 3 Annual cost of employing a chip design engineer (US-$), 2002

Location	*Annual cost*
Silicon Valley	300,000
Canada	150,000
Ireland	75,000
Taiwan	<60,000
South Korea	<65,000
China	28,000 (Shanghai)
	24,000 (Suzhou)
India	30,000

Note: *= including salary, benefits, equipment, office space and other infrastructure

Sources: PMC-Sierra Inc, Burnaby, Canada (for Silicon Valley, Canada, Ireland, India); plus interviews (Taiwan, South Korea, China)

In addition, radical changes in the methodology of chip design through the so-called system-on-chip (SOC) design have arguably further enhanced the scope of vertical specialisation within the process of design. Due to the growing complexity of the design process, a single company is no longer exclusively handling the design for a specific chip. Instead, many companies are contributing, based upon their specific areas of expertise. This leads to the development of 'global electronic design networks' that link together design houses, the licensors of specific design building blocks, design service providers, foundries, design tool vendors, design departments of large electronics systems, and brand name companies that are all contributing to the complete chip design solution.

But vertical specialisation does not imply that the 'Visible Hand' of large manufacturing firms will become invisible [20], giving rise to a resurgence of market forces. 'Integration' is the necessary complement to vertical specialisation, and the resultant geographic dispersion: large global corporations (the network flagships) can act as system integrators for the diverse, multilayered production and innovation networks that have evolved as a result of vertical specialisation [21]. Trade economists have recently discovered the importance of changes in the organisation of international production as a determinant of trade patterns [22]. Their work demonstrates that:

- Production is increasingly 'fragmented', with parts of the production process being scattered across a number of countries, hence increasing the share of trade in parts and components.
- There is reintegration through global production networks.
- Countries and regions which have been able to become a part of these network are the ones which have industrialised the fastest.

Our model of GFNs builds on this work, but uses a broader concept that emphasises three essential characteristics [23]:

1. *Scope*: GFNs encompass all stages of the value chain, not just production.
2. *Asymmetry*: flagships dominate control over network resources and decision-making.
3. *Knowledge diffusion*: global corporations (the 'network flagships') construct these networks to gain quick access to skills and capabilities at lower-cost overseas locations that complement their core competencies.

Knowledge-sharing is the glue that keeps these networks growing. Flagships need to transfer technical and managerial knowledge to local suppliers to ensure that they meet the technical specifications mandated by the flagships. Originally this involved primarily operational skills and routine procedures required for sales and distribution, manufacturing and logistics. Over time, knowledge sharing also incorporates higher level, mostly tacit forms of 'organisational knowledge' required for control, coordination, planning and decision-making, as well as for learning and innovation [24].

In short, the reintegration of geographically dispersed specialised production and innovation sites into multilayered GFNs and the increasing use of IT-based information systems to manage these networks are *gradually* reducing constraints to international knowledge diffusion. GFNs expand inter-firm linkages across national boundaries, increasing the need for knowledge diffusion, while information systems enhance not only information exchange, but also the sharing and joint creation of knowledge. This new mobility of knowledge provides new opportunities for pathways to innovation in leading Asian electronics exporting countries.

4 Policy implications

To reap these opportunities, considerable changes are required in Asia's innovation strategies, policies and management approaches. Research on Asian innovation systems [25] has emphasised that peculiar features of economic structures and institutions offer quite distinct possibilities for learning and innovation, and hence should be reflected in the design of innovation strategies. Asia's electronics exporting countries thus have to develop their own idiosyncratic approaches to innovation strategies, policies and innovation management. As latecomers to innovation, they are confronted with substantial barriers. At the same time, being a latecomer also conveys important advantages, as it is possible to learn from the mistakes of earlier latecomers to innovation.

But what precisely are the overriding objectives of 'late innovation' strategies? To find out, we use a simple taxonomy of Asian innovation strategies (Table 4). Much of the debate has focused on the transition from 'catching-up' to "fast-follower strategies" [26]. 'Catching-up' requires the mastery of capabilities that are necessary to implement, assimilate and improve foreign technologies [27]. This set of primarily operational capabilities makes it possible to enter a product market after growth has peaked, and to do so as a low-cost producer. 'Fast-follower strategies' on the other hand aim at entering a product market right at the beginning of its high growth stage. This requires a broader set of capabilities that now also includes certain aspects of innovation. However, the primary focus of innovation in 'fast-follower strategies' is on organisational arrangements that make it possible to combine quick market response ('time compression'), flexible production and systemic cost control across all stages of the value chain through supply chain and customer relations management.

Table 4 Strategies and capabilities – a taxonomy

Strategies	*Definition*	*Capabilities*	*Comments*
Catching-up	• enter after growth stage • lowest-cost producer	• operational • implement, assimilate & improve foreign technologies	• decreasing returns (employment; $; TFP) • razor-thin margins R&D • footloose investment
Fast-follower	• enter early during growth stage • quick market response • flexible production system • systemic cost control	• process development • prototype development	• profit squeeze R&D • weak marketing skills • where to move to? (paradigm shift)
Technology diversification	• Recombine (mostly known) technologies to create new products & services	• applied research • external & international knowledge sourcing • broad IP portfolio	• higher margins & limited uncertainty • new opportunities (vertical specialisation, GFNs) • latecomer advantages

Table 4 Strategies and capabilities – a taxonomy (continued)

Strategies	*Definition*	*Capabilities*	*Comments*
	• economies of scope (technology)		• build on proven capabilities
Technology leader	• Sets standard during introduction of new product/service	• basic research • pure science • defining standards • superior portfolio of IPs	• high margins (premium pricing) • strong entry deterrents • high R&D cost & risks • cost of adjusting to regulations • lower-cost imitations • 'disruptive technologies'

Asia's leading electronics exporting countries have all successfully made that transition, either for hardware or for software production. This raises the question where to move to from 'fast-follower' strategies. Research on innovation strategies in industrialised countries [28] points to 'technology leader' strategies. Here the objective is to become a prime mover of knowledge creation, and to set global standards during product introduction. The ultimate objective is to create new 'intellectual property rights', especially a broad portfolio of frequently cited 'pioneer' patents connected with important inventions and discoveries. However, jumping right into 'technology leader' strategies to compete head-on with global technology leaders is an unlikely candidate for late innovation strategies. Very deep pockets are required to finance a massive increase of R&D/sales ratios. This in turn necessitates high margins based on premium pricing during product introduction.

Most importantly, 'technology leader' strategies require a massive upgrading of innovative capabilities. As with all changes involving complex technological knowledge, this will be a "difficult, painful and uncertain" process [29]. To illustrate this, I use a classification of technological complexity of different categories of R&D, developed in [30]. 'Fast-follower' strategies demanded capabilities in both 'process development' (to reduce costs, uncertainties and time-to-market of manufacturing, and to improve flexibility) and 'prototype development' (to implement a product or system design as an engineered system through detailed product design and engineering samples). 'Technology leader' strategies however require a broad set of capabilities in 'applied research' (to transform, modify and recombine known technologies so that they fit new applications), 'basic research' (to apply new knowledge for radically new marketable products), as well as in 'pure science' (to uncover new scientific principles). To develop such a portfolio of demanding capabilities needs time.

Industrial latecomers may however have an intermediate option: 'technology diversification'. Defined as "the expansion of a company´s or a product´s technology base into a broader range of technology areas" [31], such strategies are an attempt to reap technology-related economies of scope. Technology diversification focuses on products that draw "… on several... crucial technologies which do not have to be new to the world or difficult to acquire" [32]. In terms of the above taxonomy of research capabilities, technology diversification focuses on 'applied research'. Technology diversification also implies that a company increases its reliance on outside sources of complementary technologies, including foreign ones. Empirical research on Japanese, USA and Swedish companies has demonstrated that technology diversification plays a more important role than technology substitution, as seen from the larger number of old technologies in a current product generation, compared to the number of obsolete technologies [33].

5 Conclusions

To conclude, the four global transformations discussed above have created opportunities for late innovators to engage in technology diversification that did not exist before. Asia's leading electronics exporting countries may also have important latecomer advantages. They can learn from the earlier experience of Japanese firms that have played a pioneering role in the development of technology diversification strategies [34]. Japanese firms pursued this strategy for three reasons: to compensate for the decreasing returns of their existing manufacturing exports; to develop generic technologies that could form the base for penetrating future growth markets; and to avoid the high cost and uncertainty of 'technology leader' strategies. Second, technology diversification can also build on existing strengths of Asia's leading electronics exporting countries in both 'process development' and 'prototype development', especially imitation and adaptive engineering, as well as detailed design. And third, Asian firms in the above countries can build on their accumulated capabilities to implement, assimilate and improve foreign technologies, as technology diversification often involves the exchange of knowledge with foreign parties.

References and Notes

1 Pavitt, K. (1999) *Technology, Management and Systems of Innovation*, Cheltenham: Edward Elgar.

2 Kim, L. (1997) *Imitation to Innovation: The Dynamics of Korea's Technological Learning*, Boston: Harvard Business School Press.

3 For instance, Ernst, D. and O'Connor, D. (1992) *Competing in the Electronics Industry. The Experience of Newly Industrialising Economies, Development Centre Studies*, Paris: OECD, p.303. Hobday, M. (1995) *Innovation in East Asia: The Challenge to Japan*, Aldershot: Edward Elgar. Lall, S. (2000) 'Technological change and industrialization in the Asian newly industrializing economies: achievements and challenges', in L. Kim and R.R. Nelson (Eds.) *Technology, Learning and Innovation. Experiences of Newly Industrializing Economies*, Cambridge: Cambridge University Press. Ernst, D., Ganiatsos, T. and Mytelka, L. (Eds.) (1998) *Technological Capabilities and Export Success – Lessons from East Asia*, London: Routledge Press. Mathews, J.A. and Cho, D.S. (2000) *Tiger Technology: The Creation of a Semiconductor Industry in East Asia*, Cambridge: Cambridge University Press. Ernst, D. (2000) 'Inter-organizational knowledge outsourcing. What permits small taiwanese firms to compete in the computer industry?', in *Asia Pacific Journal of Management, Knowledge Management in Asia*, special issue, August.

4 Ernst, D. (2003c) 'Pathways to innovation in the global network economy – Asian perspectives', *Oxford Development Studies*, special issue, in honor of Linsu Kim, forthcoming.

5 Baumol, W.J. (2002) *The Free-Market Innovation Machine. Analyzing the Growth Miracle of Capitalism*, Princeton and Oxford: Princeton University Press.

6 For related papers, see Ernst, D. (2004) 'Internationalisation of innovation: why is chip design moving to Asia?', *East-West Center Economics Working Papers*, No. 64, revised version, March, forthcoming in: *International Journal of Innovation Management*, special issue, in

honor of Keith Pavitt. Ernst, D. (2004b) 'Late innovation strategies in Asian electronics industries: a conceptual framework and illustrative evidence', *East West Center Economics Working Paper Series, Oxford Development Studies*, special issue, in honor of Linsu Kim, No. 66, March, forthcoming.

7 For instance, Granstrand, O., Hakansson, L. and Sjoelander, S. (Eds.) (1992) *Technology Management and International Business: Internationalization of R&D and Technology*, Wiley. Patel, P. and Pavitt, K. (1998) 'National systems of innovation under strain: the internationalization of corporate R&D', *SPRU Working Paper Series*, Science Policy Research Unit, University of Sussex, No. 22,

8 Reddy, P. (2000) '*Globalization of Corporate R&D: Implications for Innovation Systems in Host Countries*', London: Routledge. Liu, M.-C. and Chen, S.-H. (2003) 'International R&D deployment and locational advantage of developing countries. A case study of Taiwan', *East-West Center Economics Working Papers*, October, No. 62. Ernst, D. (2004) 'Internationalisation of innovation: why is chip design moving to Asia?', *East-West Center Economics Working Papers*, No. 64 (revised version, March, forthcoming in: *International Journal of Innovation Management*, special issue in honor of Keith Pavitt).

9 Ernst, D. (2003a) 'The new mobility of knowledge: digital information systems and global flagship networks', *East-West Center Economics Working Papers*, in R. Latham and S. Sassen (Eds.) *Digital Formations in a Connected World,* published for the *U.S. Social Science Research Council*, Princeton University Press, June, forthcoming, No. 56.

10 iSuppli, (2003) *China's Fabless Firms Race Beyond Foundation Stage*, report prepared by W. Byron, El Segundo, CA: iSuppli.

11 Dahlman, C.J. and Aubert, J.E. (2001) *China and the Knowledge Economy*, Washington, D.C.: World Bank Institute, The World Bank.

12 The citation index measures the frequency of citation of a particular patent. When the US Patent Office publishes patents, each one includes a list of other patents from which it is derived. The more often a patent is cited, the more likely it is a pioneering patent, connected with important inventions and discoveries. An index of more than 1 indicates that patents are cited more often than would be expected for a specific group of technologies, while less than 1 indicates they are cited less often than expected (see [35]).

13 CHI/MIT (2003) report on 'Innovation score', *Survey*, at CHI.com

14 Ernst, D. (2003d) 'Digital information systems and global flagship networks: how mobile is knowledge in the global network economy?', in J.F. Christensen (Ed.) *The Industrial Dynamics of the New Digital Economy*, Cheltenham: Edward Elgar.

15 Saxenian, A. (2002) 'The Silicon Valley connection: transnational networks and regional development in Taiwan, China and India', in D. Ernst and L. Kim (Eds.) *Industry and Innovation, Global Production Networks*, August, Vol. 9, No. 2, special issue, p.183.

16 Ernst, D. (2004) 'Internationalisation of innovation: why is chip design moving to Asia?', *East-West Center Economics Working Papers, International Journal of Innovation Management*, revised version, in honor of Keith Pavitt, March, forthcoming in special issue No. 64.

17 Foray, D. and Steinmueller, W.E. (2001) 'Replication of routine, the domestication of tacit knowledge and the economics of inscription technology: a brave new world?', *Paper Presented at The Conference, Danish Research Unit in Industrial Dynamics (DRUID)*, in honor of Richard R. Nelson and Sidney Winter, Denmark: Aalborg, June 12–15.

18 Jørgensen, H.D. and Krogstie, J. (2000) 'Active models for dynamic networked organisations', *Working Paper*, Institute of Computer & Information Sciences, Norwegian University of Science and Technology, available from Harvard.D.Jorgensen@ informatics.sintef.no

19 Ernst, D. (2004) 'Internationalisation of innovation: why is chip design moving to Asia?', *East-West Center Economics Working Papers, International Journal of Innovation*

Management, revised version, special issue in honor of Keith Pavitt, March, forthcoming No. 64.

20 As argued, for instance, in Langlois, R.N. (2001) 'The vanishing hand: the modular revolution in American business', paper presented at the conference in honor of Richard R. Nelson and Sidney Winter, Danish Research Unit in Industrial Dynamics (DRUID), Aalborg, Denmark, June 12–15.

21 Borrus, M., Ernst, D. and Haggard, S. (2000) 'Cross-border production networks and the industrial integration of the Asia-Pacific region', in M. Borrus, D. Ernst and S. Haggard (Eds.) *International Production Networks in Asia. Rivalry or Riches?*, London: Routledge. Ernst, D. (2002b) 'The economics of electronics industry: competitive dynamics and industrial organization', in W. Lazonick (Ed.) *The International Encyclopedia of Business and Management (IEBM), Handbook of Economics*, London: International Thomson Business Press. Pavitt, K. (2003) 'Are systems designers & integrators' post-industrial' firms?', in A. Prencipe, A. Davies and M. Hobday (Eds.) *Systems Integration and Firm Capabilities*, Oxford: Oxford University Press.

22 For example, Feenstra, R. (1998) 'Integration of trade and disintegration of production in the global economy', *The Journal of Economic Perspectives*, Vol. 12, No. 4, pp.31–50. Jones, R. and Kierzskowski, H. (2000) 'A framework for fragmentation', in S. Arndt and H. Kierzkowski (Eds.) *Fragmentation and International Trade*, Oxford: Oxford University Press. Cheng, L.K. and Kierzkowski, H. (Eds.) (2001) *Global Production and Trade in East Asia*, Boston: Kluwer Academic Publishers.

23 Ernst, D. (2002a) 'Global production networks and the changing geography of innovation systems. Implications for developing countries', *Journal of the Economics of Innovation and New Technologies*, Vol. XI, No. 6, pp.497–523. Ernst, D. (2002b) 'The economics of electronics industry: competitive dynamics and industrial organization', in W. Lazonick (Ed.) *The International Encyclopedia of Business and Management (IEBM), Handbook of Economics*, London: International Thomson Business Press.

24 Ernst, D. and Kim, L. (2002) 'Global production networks, knowledge diffusion and local capability formation', *Research Policy*, in honor of Richard Nelson and Sydney Winter, Vol.31, Nos. 8–9, special issue, pp.1417–1429.

25 Kim, L. (1993) 'National system of industrial innovation: dynamics of capability building in Korea', in R.R. Nelson (Ed.) *National Innovation Systems: A Comparative Analysis*, New York: Oxford University Press. Kim, L. (1997) *Imitation to Innovation: The Dynamics of Korea's Technological Learning*, Boston: Harvard Business School Press. Hobday, M. (1995) *Innovation in East Asia: The Challenge to Japan*, Aldershot: Edward Elgar. Lall, S. (2000) 'Technological change and industrialization in the Asian newly industrializing economies: achievements and challenges', in L. Kim and R.R. Nelson (Eds.) *Technology, Learning and Innovation, Experiences of Newly Industrializing Economies*, Cambridge: Cambridge University Press. Ernst, D., Mytelka, L. and Ganiatsos, T. (1998) 'Export performance and technological capabilities – a conceptual framework', chapter I in D. Ernst, T. Ganiatsos and L. Mytelka (Eds.) *Technological Capabilities and Export Success – Lessons from East Asia*, London: Routledge Press. Mathews, J.A. and Cho, D.S. (2000) *Tiger Technology: The Creation of a Semiconductor Industry in East Asia*, Cambridge: Cambridge University Press. Naughton, B. and Segal, A. (2001) 'Technology development in the new millenium: China in search of a workable model', revision of the paper presented to the second meeting on *Innovation and Crisis: Asian Technology after the Millenium*, Cambridge, September 15–16, 2000, mimeo, Graduate School of International Relations and Pacific Studies, San Diego: University of California. Liu, X. and White, S. (2001) 'Comparing innovation systems: a framework and application to China's transitional context', *Research Policy*, Vol. 30, pp.1091–1114. Yusuf, S. (2003) *Innovative East Asia. The Future of Growth*, Washington, D.C: a co-publication of the World Bank and Oxford University Press. Amsden, A.H. and Chu, W.W. (2003) *Second Mover Advantage: Latecomer Upgrading in Taiwan*, Cambridge, M.A.: MIT Press. Segal, A. (2003) *Digital Dragon. High-Technology Enterprises in China*, Ithaca and London: Cornell University Press.

26 Mathews, J.A. and Cho, D.S. (2000) *Tiger Technology: The Creation of a Semiconductor Industry in East Asia*, Cambridge: Cambridge University Press. Chang, P.-L. and Tsai, C.-T. (2002) 'Finding the niche position – competition strategy of Taiwan's IC design industry', *Technovation*, Vol. 22, No. 2, pp.101–111.

27 Kim, L. (1980) 'Stages of development of industrial technology in a developing country: a model', *Research Policy*, Vol. 9, pp.254–277.

28 OECD (2000) *A New Economy? The Changing Role of Innovation and Information Technology in Growth*, Paris.

29 Pavitt, K. (1999) *Technology, Management and Systems of Innovation*, Cheltenham: Edward Elgar, p.XI.

30 Amsden, A.H. and Tschang, F.T. (2003) 'A new approach to assessing the technological complexity of different categories of R&D (with examples from Singapore)', *Research Policy*, April 2003, Vol. 32, No. 4, pp.553–572.

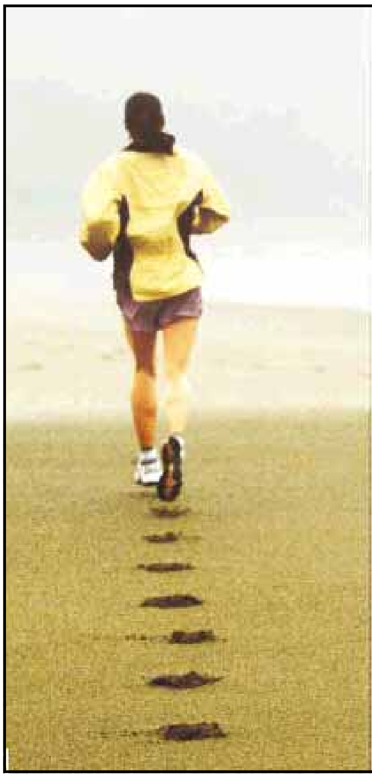
31 Granstrand, O. (1998) 'Towards a theory of the technology-based firm', *Research Policy*, Vol. 27, p.472.

32 Granstrand, O. and Sjoelander, S. (1990) 'Managing innovation in multi-technology corporations', *Research Policy*, Vol. 19, No. 1, p.37.

33 Granstrand, O., Patel, P. and Pavitt, K. (1997) 'Multi-technology corporations: why they have "Distributed" rather than "Distinctive Core" competencies', *California Management Review*, Vol. 39, No. 4, pp.8–25.

34 Kodama, F. (1986) 'Technological diversification of Japanese industry', *Science*, Vol. 223, pp.291–296. Odagiri, H. and Goto, A. (1993) 'The Japanese system of innovation', in R.R. Nelson (Ed.) *National Innovation Systems: A Comparative Analysis*, New York: Oxford University Press.

35 Narin, F. (2000) *Tech-Line Background Paper*, Haddon Heights, NJ: CHI Research, Inc., downloadable at www.chiresearch.com



Innovation in the Chilean IT Sector

German Echecopar
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Fundada en 1953

Centro de Entrepreneurship
Grupo Santander
ESCUELA DE NEGOCIOS DE VALPARAISO

Innovation in the Chilean IT Sector

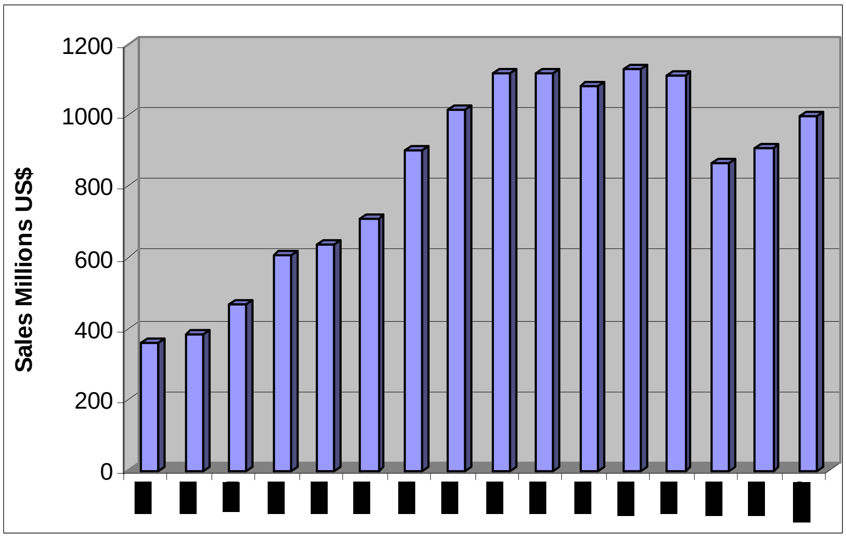
Topics:

- IT background in Chile
- Innovation Incentive Model
- Main findings in Chilean IT sector:
  - Demand
  - Supports
  - Competitive context
- Some APEC economies comparisons
- Conclusions

IT Development Background

- ❑ Strategy for digital economy (1998)
- ❑ Presidential instructive (2001)
- ❑ Regulatory changes (2000)
- ❑ Fundacion Pais Digital (2000)
- ❑ Legislation: digital signature (2001), electronic invoice (2004)
- ❑ Chief Information Officer (2003)

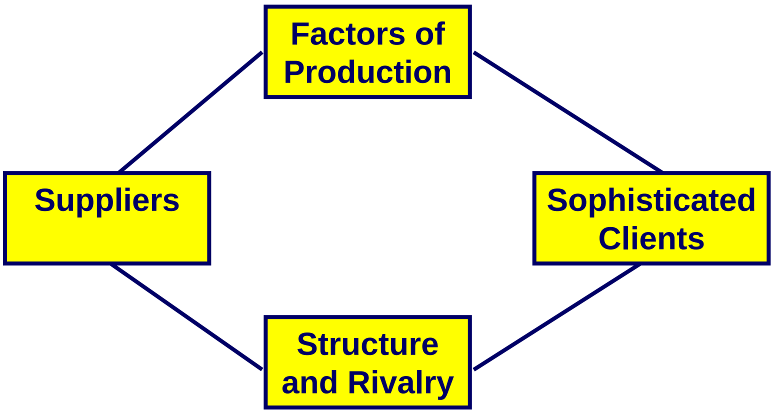
IT Sales in Chile



* For 2004 the figure is a forecast.
Source: ACTI (20035)

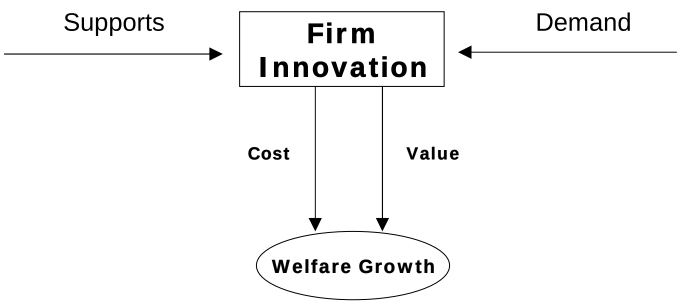
Innovation: Porter's Cluster Model

Most competitive clusters when all areas focused on innovation

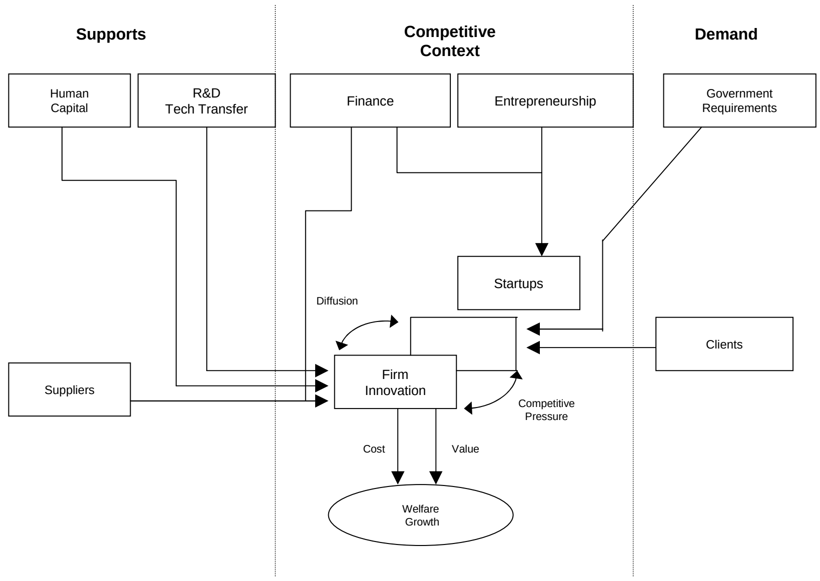


Innovation Incentive Model

- Firms produce innovations that create welfare growth
- Look at innovation system from firms' incentives perspective: benefits & risks



Innovation System



Methodology

- Gather industry data on each element of the innovation system
- Interviews with more than 20 industry experts, entrepreneurs and managers about market dynamics and policy

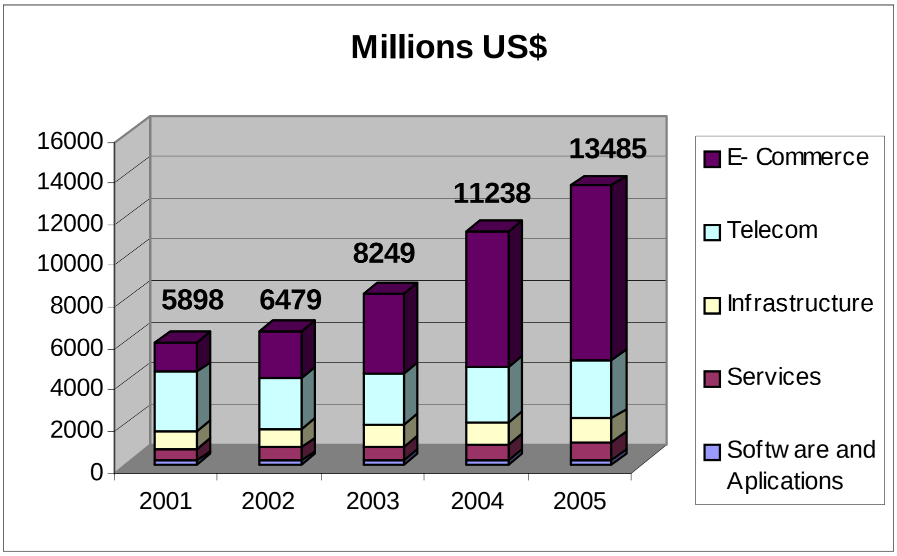
IT Demand

IT Expenditures

	Millions US$		Growth	Per Capita US$
	1997	2001	2002/1997	2002
Chile	1,001	1,039	3.8%	67.0
Brazil	11,424	11,458	0.3%	67.2
Argentina	2,685	1,366	-49.1%	35.9
Colombia	1,065	1,344	26.2%	30.6
Mexico	3,791	6,228	64.3%	61.2
Venezuela	1,219	1,572	29.0%	62.4
USA	320,986	456,366	42.2%	1626.4
Chinese Taipei	3,053	4,279	40.2%	232.4
Japan	99,312	107,094	7.8%	939.9

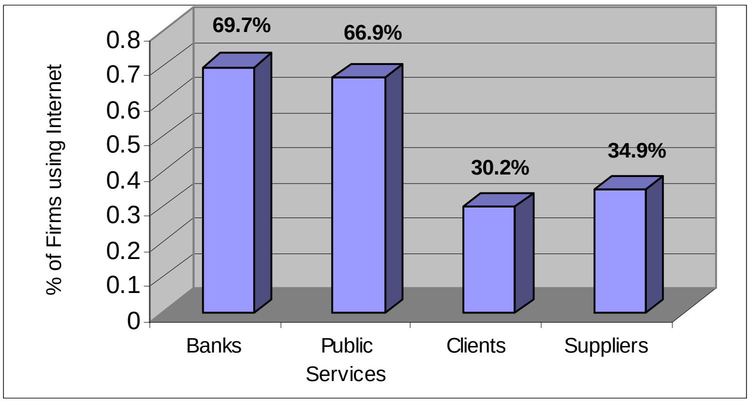
Source: IDC (2002)

Digital Economy in Chile



Source: CCS (2003)

Internet Use in Firms



Source: MINECON (2002).

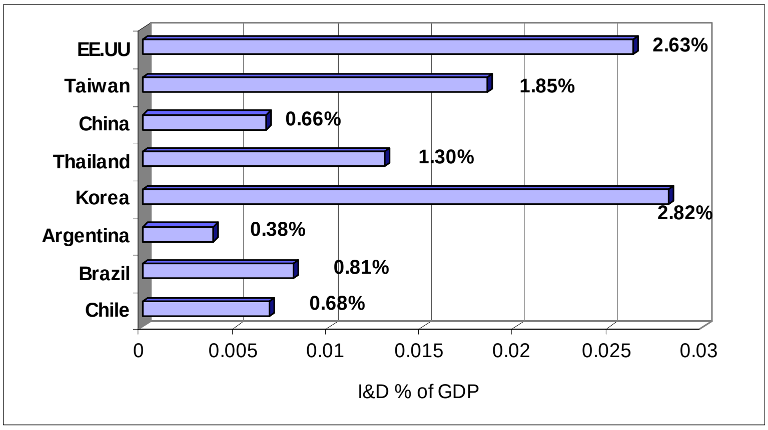
Findings

- Demand and innovation incentives
  - Recent demand growth: Internet, banks and government
  - Government sophisticated client and expanding IT needs
    Banks sophisticated but slower expansion of IT needs
    Natural resources clusters and retailers demand quality but focused on price, not innovation
    No local demand for certifications (ISO, CMM)
  - Households:
    Relatively (LA) high internet penetration, little e-transactions

IT Supports for Innovation

R&D Expenditures

% of GDP



Source: Schawb et al (2002)

- Chilean IT firms invest 1.1% of sales in R&D (Chileinnova 2004)

Public Innovation Financing

Annual average (Millions US$)

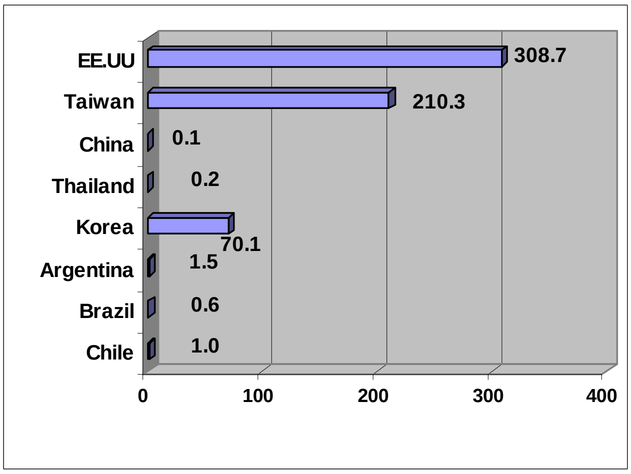
	FONDECYT	FONDEF	FONTEC	FIA	FIP	FDI	TOTAL*
1980-1984	0.5	0.0	0.0	1.0	0.9	0.1	2.5
1996-2001	33.3	15.2	12.5	5.7	5.2	11.9	83.9
Cummulative Total ($)	364.7	178.3	117.2	47.3	36.5	79.6	854.9
Cummulative Total (%)	42.7%	20.9%	13.7%	5.5%	4.3%	9.3%	100%

Source: CONICYT (2001)

- Functional approach
- R&D expenditures focused on academic interests, not innovation impact
- Less than 20% of IT firms have links with universities (Chileinnova 2004)

Patents in USA

Per million population Year 2000



Source: Schawb et al (2002)

Findings

- **Supports**
  - **Local suppliers less competitive than foreign companies**
  - **Human capital**
    - OK Engineers: 17% College students, 2nd in Bruner (2004) sample
    - Low Researchers: 0.12% Population, 12th in Bruner (2004) sample
    - IT sector only 7.4% of employees have postgraduate studies (50%u)
    - IT main perceived advantage: quality of human resources
  - **R&D: low amount, good quality but little applied**
    - 80% of R&D is public and mostly with universities
  - **Risk capital:**
    - Modern legislation and improving
    - Low amount of risk capital and very cautious
    - Current angels lack experience with technology
    - Few venues for matching few deal flow with angels
    - IT firms' main perceived barrier and weakness: financial resources

IT Competitive Context

Findings

- **Competitive Context**
  - **Few IT firms internationally competitive**
    Strong local competition based on price for low cost small local solutions (3.6% of sales are exports, 1 in 6 export)
    Main perceived threat: low economic growth
    Business strategies: new (48%) & existing (31%) products for existing markets
  - **Cooperation is low but increasing**
    No formal diffusion mechanisms
  - **Emerging entrepreneurial spirit** (40% firms less 10 years, 26% M&L)
    Still local focus: lack of English, distribution networks, managerial skills and island mindset precludes global vision

APEC Comparisons

APEC Comparisons: NICs

- **NICs tend to have target government policies for IT**
- **Advanced manufacturing sectors and government purchasing preferences provide demand for sophisticated IT solutions**
- **Greater innovation interaction university-business**
  - Incubators & SP: Korea (230), Taiwan (55), Chile (12)
  - TLOs in Japan, Korea, Malaysia, Taiwan
- **R&D more focused because of:**
  - Specific institutions for R&D and tech transfer
  - Corporate governance of these institutions with private firm input
  - Relaxed restrictions on professors commercializing scientific findings
- **Financing entrepreneurship: more aggressive legislation**
  - Angel legislation: lower capital gains tax, loss carryover
  - Second and third tier stock markets: listing, delisting
  - Public funds and guarantees

Conclusions

Conclusions

- Some incentives to innovate from banks and government,
  but overall local market is small and low growth
  Because of local size, difficult to escalate to export products (3.6%)
- Supports:
  Suppliers and education (technicians & engineers) are OK
  Low number of researchers and low research-business links
  precludes the creation of top notch products
  Financing main perceived barrier to grow
- Competitive context does not promote innovation:
  Few innovative start ups, focus on local markets, cost based
  competition, little cooperation
- APEC NICs have:
  More targeted policies aimed at increasing business-university links
  More aggressive risk capital market legislation
  Strong export manufacturing creates greater demand for IT
  innovation

Conclusions

- Opportunities for exporting local solutions in bancs and government to LA are hindered by costs and risks of distribution in small markets were local networks are key for growth
- Opportunities to create a competitive advantage in the IT sector can come through creating IT solutions for world class local clusters in natural resources (mining, salmon, wood, wine, fruits)
- Policy proposal analysis should look at two incentive systems: Creation and propagation of innovations

Centro de Entrepreneurship
Grupo Santander
ESCUELA DE NEGOCIOS DE VALPARAISO

UNIVERSIDAD ADOLFO IBAÑEZ
Fundada en 1953

Use of Internet

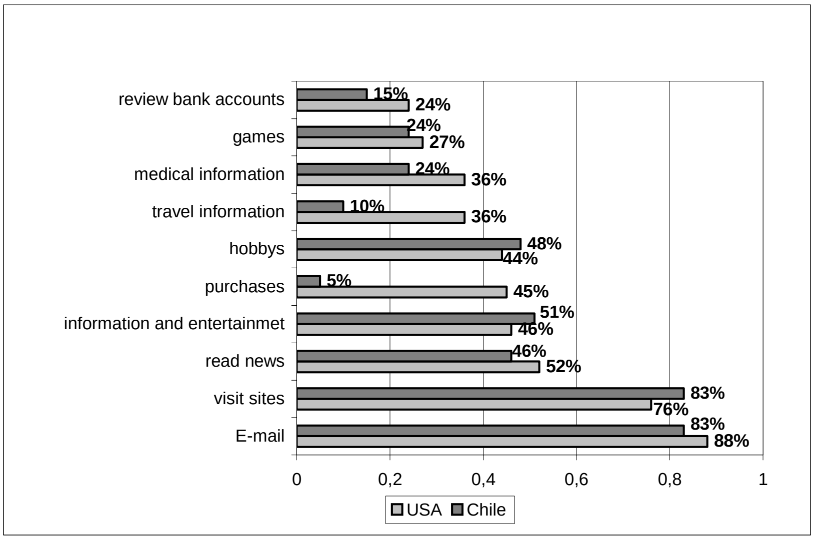
(% firms)

Country	Connected	Have Website	Sell in Internet	Buy in Internet	Pay taxes
Sweden	98	80	43	70	12
Germany	97	85	47	44	4
Canada	86	68	30	47	8
Great Britain	91	80	32	50	4
USA	91	78	34	56	11
Italy	96	58	33	35	8
Ireland	88	68	36	38	8
Australia	84	64	37	43	16
Japan	92	79	40	28	2
France	83	56	18	30	18
Chile	**69**	**25**	**11**	**16**	**49**

Source: CCS (2003)

Use of Internet

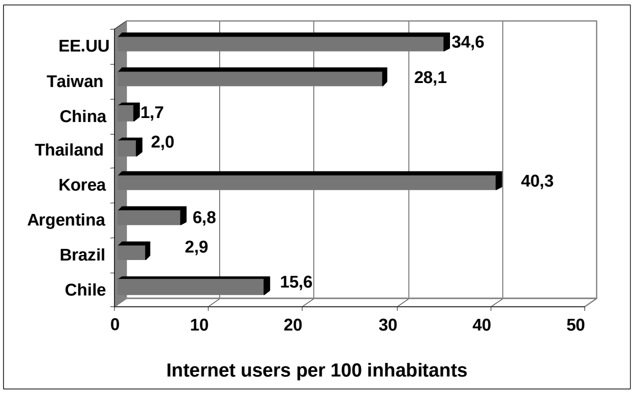
(households)



Source: CCS (2003)

Internet Users

Year 2000



Source: Schawb et al (2002)

Private Investment Funds

US$ Millions

Investment Funds	1996	1998	2000
Risk Capital	117	153	164
Total Assets	1.105	1.287	1.421

Souces: SVS (2002)

Proposals

- **Incentives**
  - Government can become most sophisticated client:
    Demand exportable advanced solutions
    Require CMM certification (suppliers development plan)
  - Government and business associations can improve local demand:
    Reduce risk perception of electronic transactions
    Promote applied IT R&D for nat. resources clusters
    Support IT adoption for IT and nat. resources cluster

Proposals

- **Supports:**
  - Assign public R&D decision rights to firms
  - Government and businesses can help create institutions to transform R&D into business projects
  - Increase digital training at schools and broad band access
  - Provide full access to English learning at schools

- **Industry Dynamics:**
  - Improve IT deal flows and create matching system for investors and entrepreneurs
  - Motivate entrepreneurial activity (showcase successes, provide training)

2005 APEC SYMPOSIUM ON INDUSTRIAL CLUSTERING

The Role of Government in Supporting Collaboration and Interlinkages

Roger Wigglesworth

New Zealand

THE ROLE OF COLLABORATION

- *Contributing to economic development by overcoming information and investment barriers*
- *Benefits of collaboration: scale, scope, quality, buying power, marketing, sharing risk, co-specialisation*
- *Spillover benefits*

NEW ZEALAND CONTEXT

- *Small domestic market and distant from international markets*
- *Culture that values individualism*
- *Paucity of management capability*
- *Government interventions focussed on business capability development*

SECTOR APPROACH

- *Sector initiatives facilitate interaction between players, raise awareness, provide information*
- *Encouraging innovation and pooling of resources*
- *Recognising competitive advantages through better interlinkages*
- *Must be sector-led*

APPROACH TO INCUBATORS

- *Business incubation to promote commercialisation of ideas*
- *Coordinating investment and production decisions*
- *Building business capability and awareness in SMEs*
- *Government funding to promote incubator best practice*

CONCLUSIONS

- *Well-run, innovative and world-class businesses*
- *Collaboration to overcome barriers to growth*
- *Support for firms looking to build business capability and seeking business information*
- *Partnership approach, led by sector/businesses*

The Impact of Network Structure on Corporate R&D Investment

Deuk Kyu BOK and Yong Kyu PARK

Samsung Economic Research Institute

Contents

Motivation

❖ **Network structure** (degree of Info. & Knowledge sharing and degree of competition between firms)

vs. Individual Firm's R&D

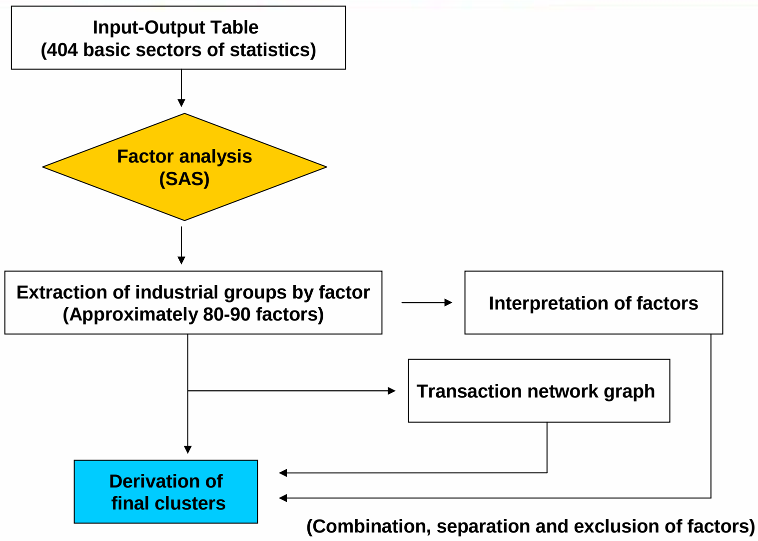
"Clustering externalities cause companies to decrease R&D investment." (Externality Hypothesis)

"Firm competition in a cluster increases R&D investment." **(Competition Hypothesis)**

Contents

2. Identifying Clusters

Identifying Clusters for Three Sectors



Selection of Industrial Sectors for the Study

Region	Sector	Cluster	Reason for Selection
Seoul	Pharmaceuticals	Pharmaceuticals Industry	Promising sector (biotechnology) Regional uniqueness
Incheon	Auto Parts	Auto Parts Industry	High portion in the region
Kyonggi	PCB	Computer and Peripheral Devices Industry	Core parts industry in the IT sector

3. Empirical Analysis

Data & Variables

- **A survey of the three sectors**
  - **Mailing and door-to-door visits during April 8-21, 2004**
  - **77 Samples for R&D costs-to-sales**
  - **91 Samples for researchers-to-employees**

- **Dependant Variables: R&D Investment**
  - **R&D expenditures-to-sales**
  - **# of Researchers-to-employees**

Data & Variables

❖ Independent Variables

- ➢ Degrees of Networking for Research Network, Development Network and R&DM Network
- ➢ Degrees of competition between firms

❖ Control Variables

- ➢ Geographical proximity of members in a cluster
- ➢ Size of firms calculated by the number of employees
- ➢ Sector-dummy variables

Correlation among Variables Related to R&D Costs

Variables	Avg.	S.D.	Correlation						
			1	2	3	4	5	6	7
1. R&D Cost-to-Sales Ratio	8	21.70	-						
2. R&DM Network	3	1.12	0.34	-					
3. Research Network	3	1.20	0.32	0.99	-				
4. Development Network	3	1.18	0.28	0.98	0.97	-			
5. Degree of Competition	5	1.39	-0.21	0.60	0.58	0.95	-		
6. Geographical Proximity	3	0.78	-0.31	0.19	0.11	0.27	0.08	-	
7. Number of Employees	2	0.61	0.26	0.22	0.15	0.23	0.08	0.00	-

Correlation of Variables Related to Researcher Ratio

Variables	Avg.	S.D.	Correlation						
			1	2	3	4	5	6	7
1. Number of Researchers-to-Total Employee Ratio	8	18.27	-						
2. R&DM Network	3	1.10	0.11	-					
3. Research Network	3	1.20	0.12	0.94	-				
4. Development Network	3	1.15	0.15	0.96	0.87	-			
5. Degree of Competition	5	1.48	-0.23	0.17	0.21	0.13	-		
6. Geographical Proximity	3	0.77	-0.15	0.02	0.02	0.03	0.33	-	
7. Number of Employees	2	0.61	-0.40	0.46	0.41	0.41	0.13	0.01	-

Estimated Results of R&D Investment

Independent Variable	Model 1	Model 2	Model 3
Constant	39.46 (3.24)***	39.33 (3.29)***	40.20 (3.29)***
R&DM Network	3.04 (1.19)	-	-
Research Network	-	3.97 (1.77)*	-
Development Network	-	-	1.99 (0.83)
Degree of Competition	-5.61 (3.14)***	-5.93 (3.34)***	-5.42 (3.04)***
Geographical Proximity	0.70 (0.29)	0.51 (0.16)	0.77 (0.24)
PCB Sector	7.62 (1.25)	8.21 (1.38)	7.17 (1.16)
Pharmaceuticals Sector	17.95 (2.78)***	17.56 (2.80)***	18.66 (2.89)***
Number of Employees	-14.24 (3.44)***	-14.86 (3.67)***	-13.59 (3.30)***
Adjusted R-square	0.22	0.23	0.20
F-Ratio	4.41***	4.79***	4.24***

Estimated Results of Researcher Investment

Independent Variable	Model 1	Model 2	Model 3
Constant	34.36 (4.75)***	34.63 (4.79)***	34.25 (4.72)***
R&DM Network	4.44 (2.68)	-	-
Research Network	-	3.82 (2.62)**	-
Development Network	-	-	4.04 (2.60)**
Degree of Competition	-1.82 (1.68)*	-1.90 (1.73)*	-1.65 (1.53)***
Geographical Proximity	-1.12 (0.52)	-0.97 (0.45)	-1.35 (0.63)
PCB Sector	2.80 (0.73)	2.46 (0.64)	3.01 (0.77)
Pharmaceuticals Sector	16.87 (4.44)***	17.29 (4.58)***	19.03 (4.48)***
Number of Employees	-17.72 (6.55)***	-17.13 (0.45)***	-17.20 (6.50)***
Adjusted R-square	0.44	0.44	0.43
F-Ratio	12.65***	12.55***	12.52***

4. Implication & Limitation

Implications

- ❖ The information and knowledge exchanged within clusters should be useful to firms.

- ❖ Corporate competition should be geared more towards developing technologies.

Limitations

- ❖ This paper only covered the effects of externality and competition on firms' R&D investment.

- ❖ The characteristics of competition is not classified.

- ❖ Other variables may affect corporate R&D investment.

Thank you for your attention!

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University Focused Clusters of Innovative SMEs. Evidencies of Experiences and Emerging Patterns from Tuscany

Dr. Simone Tani
Manager for Economic Development
Province of Florence

Aper Symposium on Industrial Clustering for SMEs
Chinese Taipei . March 7-9, 2005

The policy guidelines that may be drawn from this presentation fit the OECD framework for SMEs:

Increase the participation of SMEs in research networks and technology markets. This includes greater SMEs involvement in existing public-private partnerships that connect science to innovation.

Support the emergence and maintenance of innovative clusters. Help local actors implement the cluster strategies primarily through schemes to stimulate collaboration beween public and private research institutions.

Improve access to financing for SMEs on reasonable terms. While SMEs financing requirements differ at each stage of their development, policies should aim to ensure that markets can provide financing for credit-worthy SMEs and that innovative SMEs with good growth prospects have access to appropriately structured risk capital at all stages of their development
(Istanbul OECD Ministerial Conference Declaration and Papers, June 2004)

SMEs ability to manage innovation may be improved by: facilitating the hiring and training of qualified personnel and diffusing an innovation culture (eg. Through linkages between industry and public and university research).
(Bologna Charter on SME Policies, June 2000)

How to make these policies work?

International Evidences

Literature on *localised knowledge spillovers*:

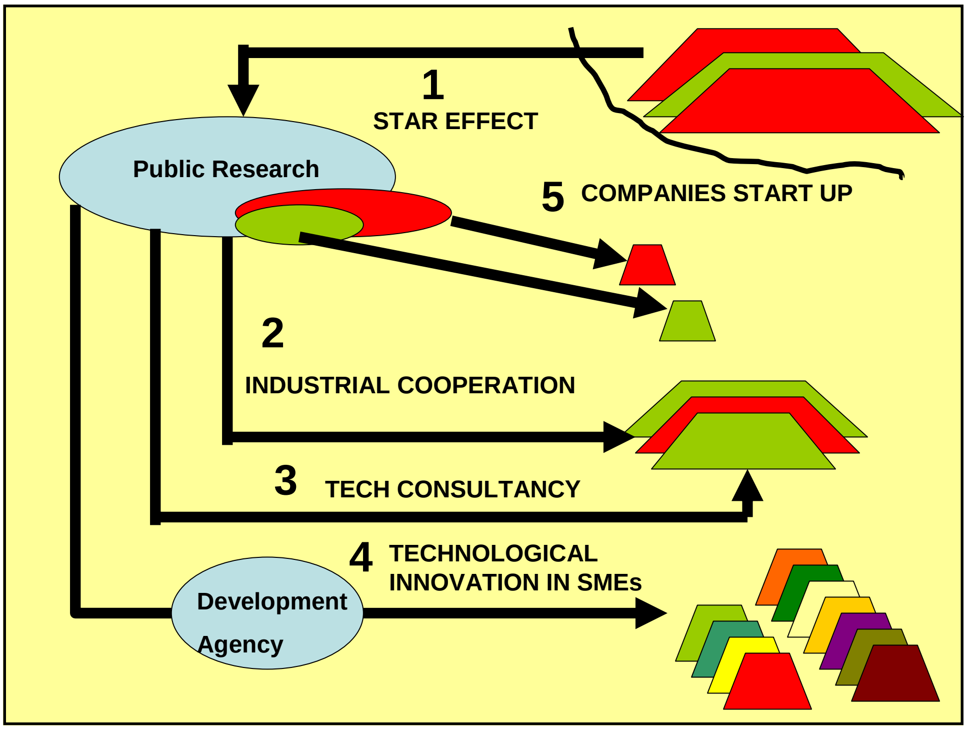
-Companies prefer to work with researchers of local universities (within 100 miles from thei own labs)

-The Technological Knowledge developed from Universities (patents) is utilized on average most likely in the local environment

-There is a a positive correlation between the employment percentage in high tech sectors and volume of R&D public spending at local level

-The industrial specialization tends to follow the scientific specialization at the local level

How to maximize the positive impact of R&D on local development?



(1) STAR EFFECT

High tech companies use to establish a part of their labs next to “scientific stars”, scientists who develop important discoveries and train high quality talent.

The presence of international quality research is a key rationale for attraction of high tech investments at local level

Pre conditions:

- strong scientific leadership
- possibility to develop talent pipelines (post doctoral)
- top level technological infrastructures

(2) INDUSTRIAL COOPERATION

The Italian Public Research System in Italy has traditionally a weak attitude towards structured, strategic and long term cooperation with industry

In particular, strategic cooperation rooted in joint industry-academia research centres is still at the beginning of the development process

Even though there is no evidence at all, there is a cultural concern of loosing scientific freedom in recearch

University Ranking according to percentace of University budget funded by industry. Average 1994-1999

Rank	Ateneo	Perc_trasf_priv	Rank	Ateneo	Perc_trasf_priv
1	Torino Politecnico	6,99	26	Verona	1,63
2	Genova	6,27	27	Venezia	1,50
3	Roma Tor Vergata	5,69	28	Modena	1,47
4	Trento	4,55	29	Molise	1,37
5	Pavia	4,22	30	Cassino	1,27
6	Brescia	3,87	31	Cagliari	1,21
7	Sassari	3,86	32	Bologna	1,13
8	Milano Politecnico	3,74	33	Viterbo Tuscia	1,12
9	Padova	3,69	34	Calabria	1,10
10	Ancona	3,59	35	Napoli Navale	0,94
11	L'Aquila	3,54	36	Lecce	0,84
12	Siena	3,42	37	Trieste	0,77
13	Chieti	3,34	38	Napoli II	0,67
14	Parma	3,24	39	Napoli Federico II	0,44
15	Milano	3,04	40	Bergamo	0,35
16	Torino	2,86	41	Teramo	0,34
17	Udine	2,56	42	Roma Sap	0,33
18	Bari	2,37	43	Salerno	0,32
19	Roma III	2,16	44	Palermo	0,26
20	Perugia	1,95	45	Napoli Orientale	0,17
21	Ferrara	1,88	46	Messina	0,12
22	Pisa	1,83	47	Reggio Calabria	0,02
23	Firenze	1,76			
24	Basilicata	1,73			
25	Catania	1,69			

Recent Evidences on the Italian Research System

- The total funding of the university departments and the industry funding are both correlated to the number of **international papers** (*not* national) (Orsenigo e bruno, 2003)
- The funding of the National Research Institutes coming from external sources (industry, EU, other public bodies) is correlated to the scientific productivity of the researchers neasured through international papers (Bonaccorsi e Daraio, 2003)

(3) TECHNOLOGICAL CONSULTANCY

• Around 70% of the companies in Italy develop some form of research with external bodies (National Institute of Statistic).

• Preferred forms:
- Contracts with other firms
- Joint projects
- Use of consultants

The use of consultants is the more widespread form, utilized by 45% of the companies

(4) TECHNOLOGICAL INNOVATION IN SMEs

• The min organizational pre-requisite for SMEs to develop some innovative activity is not the presence of technological labs, but the presence of a **technical office**

• The structure of the technical offices is very simplified (typically, max an engineer and a small group of technicians)

• The main source of innovation comes from the **customers**

• **SMEs** collaborating with universities are only those which: a) have a structured technical office; b) have graduated employees

Source: Bonaccorsi et al. (1999)

Attitude to absorb innovations

• Only **15%** of the micro-enterprises (less than 10 employees) declare to be innovative

• Within the environment of the few innovative micro-enterprises only **4%** declare to have received innovative inputs from the university

Source: ISTAT, Multipurpose Analysis (2004)

On going experiences of SMEs innovation support at local level

In front of the difficulties of the SMEs-innovation framework, a new set of relationships *at the local level* is designing innovative experiences where Universities, bridging institutions and SMEs are trying to overcome some of the critical issues.

A **Field Action Model** is emerging:
-Competitive audit
-Assessment of technological potential
-Qualified human resources (graduate, master, PhD)
-First stage of consultancy free (public funding), then mixed model, then private funding
-Public funding not to compete with the market, but to create the market

Some on going examples…

Firenze Tecnologia

• **Agents of innovation** project (2004-2006)

• 7 young graduates, technical and managerial background

• audit approach

• support (not easy) of the the local industrial association

• development of a knowledge management system

• development of a training package (24 days)

• first results not easy but encouraging. The first wave of second step consultancy contracts are coming…

Some on going examples…

Master in Innovation Management, Pisa

• Project: Assessment of the innovative potential

• 7 teams of master graduates, supported by an academic tutor, have developed projects in 10 SMEs

• Methodological support of a senior consultant

• Development of consulting tools

• Industries: mechanic, furnitures, leather, food

•Support of the local Chamber of Commerce (2005)

Some examples...

The **link project** (1996-2002), moving the labs of **Scuola Superiore S.Anna** out of the city, next to the plant of the scooters company **Piaggio** and its **suppliers network** has proved to be a great opportunity to launch SMEs tailored projects in a mature industry.

Key lessons:

Technology transfer as a linear model from research to industry, according to a framework managed by the supplier, is a very week model for small SMEs in mature industries. Rather than concentrating in transferring packaged solutions, better has proved to concentrate efforts to **create something new together**, accepting the cultural differences and the different ways of looking at the same problems

The **link project** has created ***dialogue professionals,***rather than technology experts with *ready to use* solutions.

Real partnership, based on **mutual trust**, requires research of a common language and joint design approach

Common features of the most advanced experiences

- **Public-private** integrated model, evolving at the diverse stages of the process
- Emphasis on the quality of **human resources**
- **Audit/assessment methodologies** as tools to let the implicit demand of innovation come out
- **Tools development** (conceptually sophisticated but easy to use and re-usable)
- **Company impact,** easy to perceive
- Need to **rethink** “technology transfer”

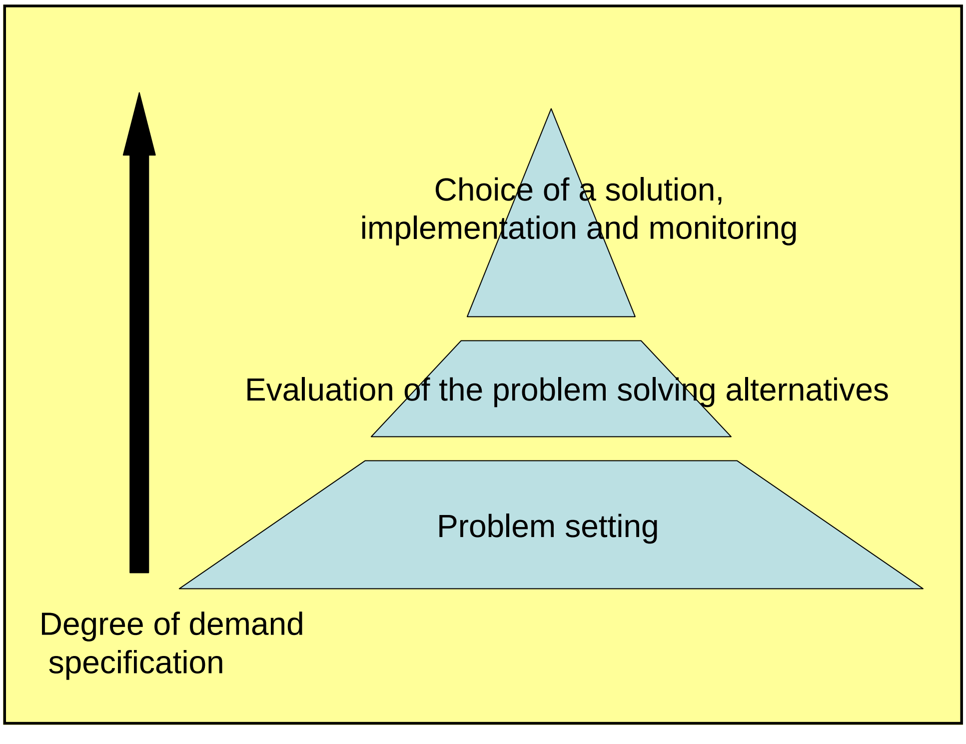
Summary

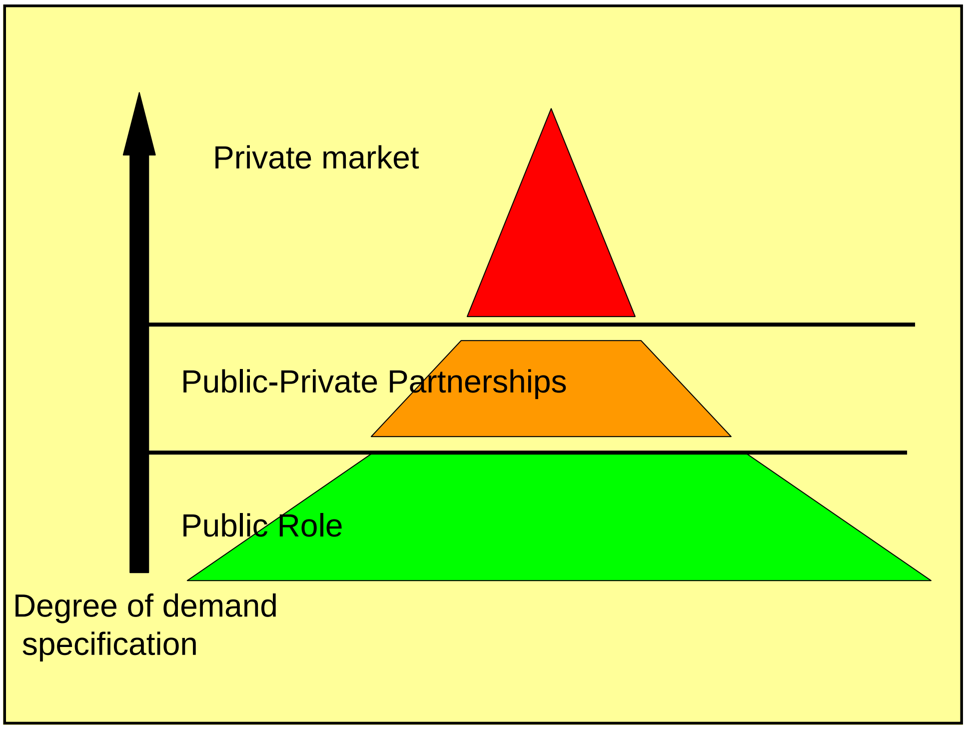
• SMEs need to innovate either in products, processes and organizational capability. Academia and bridging institutions may play a critical support role, as in the tuscan experiences, but…

• …innovations need on the SMEs side a structured effort to be able to be **absorbed** . There is a minimum threshold internal capability under which it is almost impossible to manage innovative processes

• SMEs need first to get more qualified **human resources**, expecially in the technical field. This is a pre-requisite to be able to innovate in a permanent and structured way

• The “demand for innovation” has to be **extracted** from SMEs





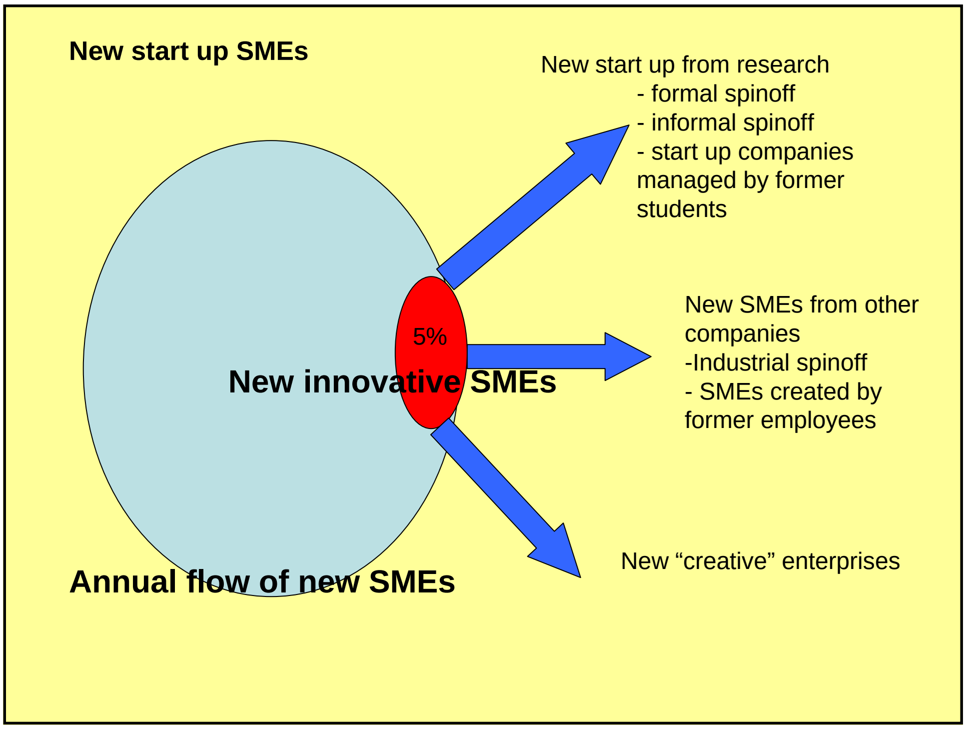
(5) National Evidencies on new SMEs

Every year 250.000 new firms are registred in Italy

On average the size growth in the first few years is limited: 11% in the first three years, below the international standards (Unioncamere Research Centre)

Many of those firms have almost no employees, at least in the first few years

Within the segment of the new companies created every year, **around 5%** declare that the enterpreneurial decision is due to the need to exploit an innovation (Source: Unioncamere, 2003)



Innovative SMEs have more difficulties to succeed

- the enterprepreneur often has a good product or service idea but lacks the management competencies to implement it
- revenues are most likely to be obtained 3 or more years after the launch of the new company. Financial issues…
- being companies based on intellectual capital, they do not usually have the tangible assets which are required for average bank credit
- venture capital basically does not finance the early stage development of a business idea o company, or at least the size of the investment has to be significant (1-2 millions euro). Unfeasible for small deals

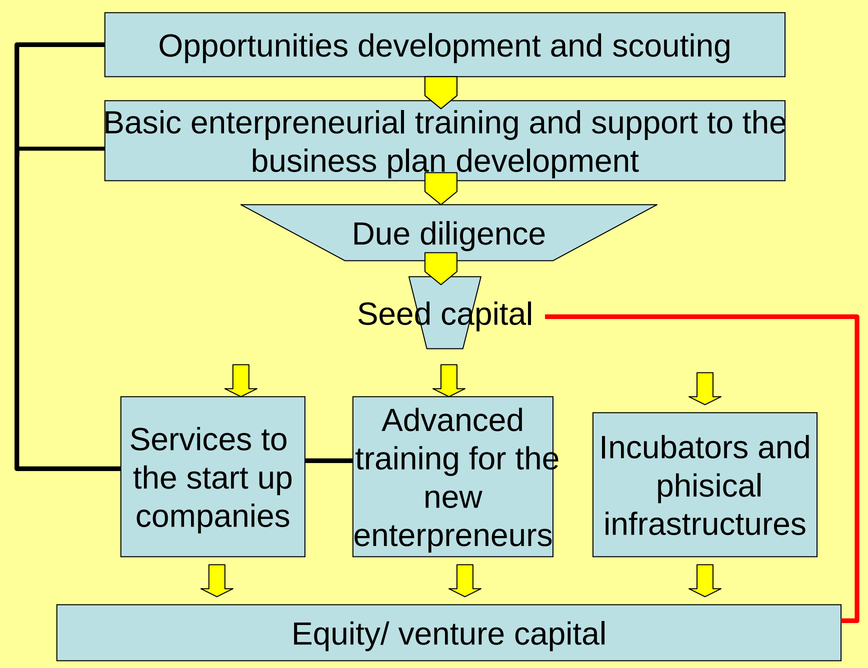
Key indgredients for the development of innovative SMEs from research at the local level

- Good quality **research**
- Support Services:
  - scouting
  - business plan support
  - training for new enterpreneurs
- Independent due diligence
- Early stage financing and seed capital
- Phisical Infrastructures

university plays a key role in all the areas in the Tuscan experience

Multiplicative model, not addictive

The local approach, developed at the university of Pisa



Support to business plan development

Product idea

- intellectual property rights
- prototypes
- industrial validation

Business Idea

- target market analysis
- market segmentation
- *willingness to pay* of potential customers
- business model

Company idea

- enterpreneurial team
- organization

Business Plan Validation

Business Plan Evaluation

Due diligence

Evaluation steps:
- screening
- in depth due diligence
- technical sectoral evaluation.

Business plan developed by innovative SMEs linked with research has to be evaluated according to high:
- professional skills
- independent attitude
- trasparency.

-It is a *new job* for the local financial/academic system!
-It is highly advisable that at least the *in depth due diligence step* may be developed by *external actors*

Finance for the start up of innovative SMEs

Early stage financing
Finance for SMEs in the applied research and industrial development step or SMEs having fullfilled the product development step and looking for additional resources to get to the production and commercialization steps

Typical financial size deal < € 500,000

Seed money: € 100-200,000

Source: European Venture Capital Association (EVCA)

Financing innovative SMEs is often a critical issue…

Market failure

In most of the advanced countries private venture capitalists, even though interested in dealing with start up companies, they do not consider business plan requiring less than 1-2 millions euro of external finance

Key reasons are:
- high risk
- relatively high evaluation costs (due diligence)
- monitoring costs too high when compared to the size of the investment

The italian experience shows critical issues:

Lack of deal flow

- ✓ Institutional investors and venture capitalists are not interested in investing in deals without some scale economies (still there are few deals and different each other)
- ✓ The quality of the business plans is often poor

Seed capital

- ✓ Venture capitalists are focused on bigger financial deals (1-2 millions euro or more)
- ✓ Business angel networks do not work in Italy
- ✓ Finance for the early stage lacks operative tools

Innovative solutions for market failure

Seed capital

-Developed by public or public-private institutions.
-Based on the investment in the equity of the SMEs (3-5 years)
-Light operative models, but based on the specialized skills of the financial markets
-Strategic alliances with private venture capitalists

Fondi chiusi di investimento

Funds dedicated to highly innovative start up on a national basis and focused on selected industries

Regional initiatives launched by public institutions

Key solutions developed at the local level by capitalizing on experiences and clustering university, chamber of commerce, local public and financial institutions

Some experiences developed in Tuscany

Fondo rotativo per le nuove imprese innovative

Percorso di accelerazione delle nuove imprese

Fondo rotativo per le nuove imprese innovative (Rotative Fund)

Key actor: Pisa Chamber of Commerce
- mission: support the local development
- possibility to buy stocks of innovative SMEs
- strong links with the local environment
- University of Pisa consultant for the Project
- good availability of finance for small deals

key milestones:
Project: november-december 2002
Legal frameworks and acts approval: December 2002 up to March 2003
Call for business plans: June 2003, June 2004, November 2004
Due diligence: within two months after the project is submitted
Financial arrangements: within the following three months

Features

- committment 2,5 mn € in 3 years, 775 k € in 2003, 850 in 2004
- 700 k € for investments, 75 k € for initial communication, administration and due diligence
- equity participation up to 200k € according to SMEs regulation
- only for capital companies (not cooperatives or no profit)
- only **innovative** companies (parameters: product,process or method innovation; constant R&D activity; spinoff; structured relations with universities)
- only new companies (not yet existing or created less than 3 years before)
- established in the Pisa area
- arrangement of a **buyback agreement** on the enterpreneur side after 3 years

Features (2)

- strong **Technical Committe** (4 members: scientists with relevant experience in high tech business start ups + finance and management experts)
- financial, economic and technological evaluation **purely technical** (Chamber of Commerce has no right to select)
- initial screening within the Committee
- the projects selected by the Committee receive a further **external independent evaluation**
- the 12 external evaluation companies have been selected through an open tender
- the Technical Committee arrange with the selected innovative companies their *buyback customized structure*, by combining:
    - fixed price
    - market evaluation of the stock

Features (3)

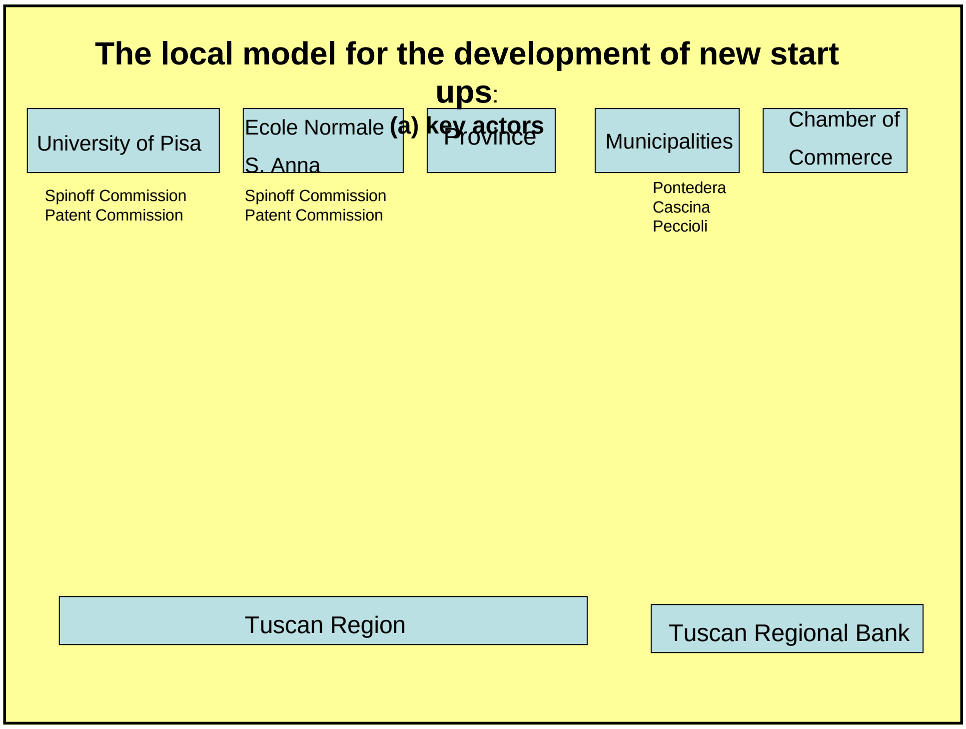
- **periodic evaluation** of the companies according to economic and financial criteria (but not participation in the board)
- control of the investments through the development of **professional and social links** with the new enterpreneurs
- development of the **Club of the Innovative Companies**
- formal agreements with private Venture Capital Funds for **monitoring** the new companies . The funds participate in the social network of the new companies
- VC funds have time and opportunities to know in depth the companies, in order to be able to consider them for the **second round** of financing once the first developmental phase is over

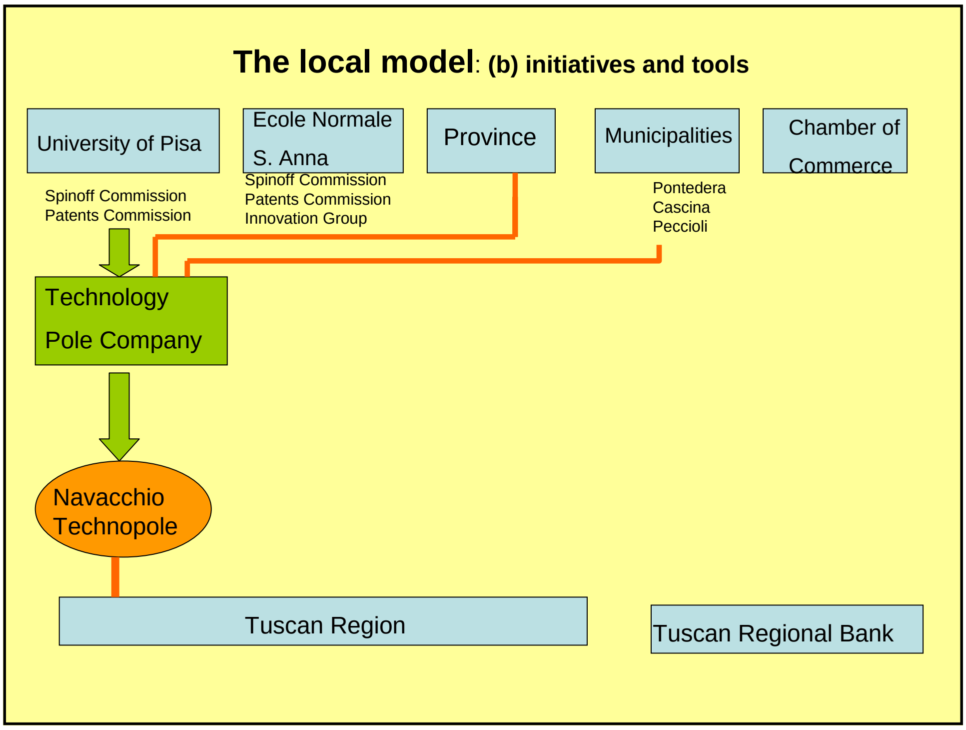
Results up to now

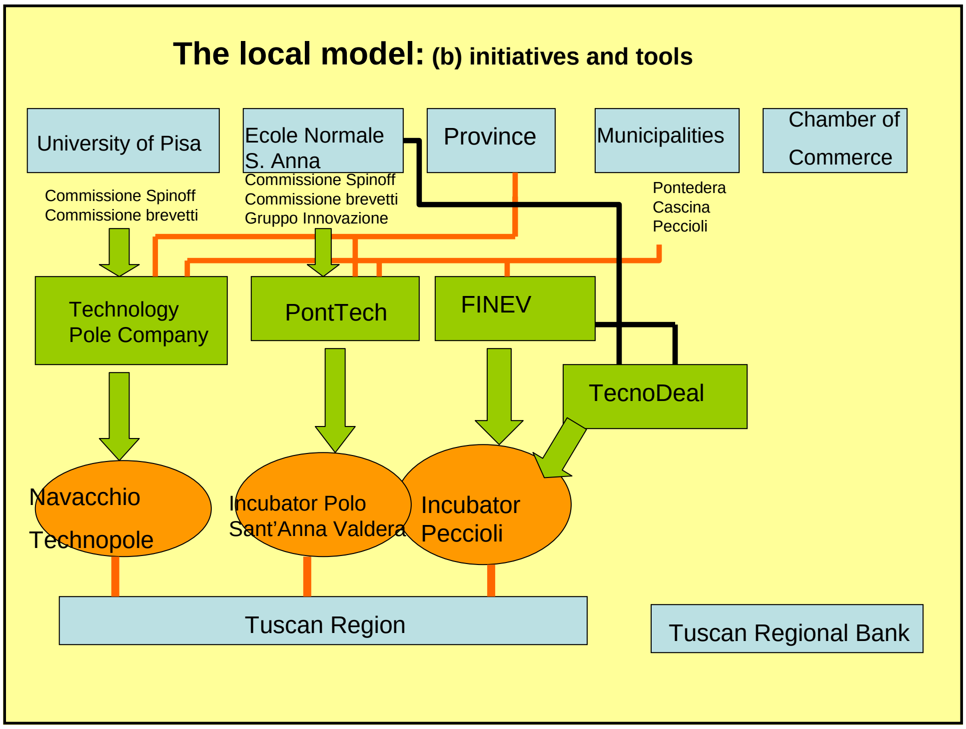
- 27 projects received in 2 years
- 10 projects eliminated during the first screening step
- 6 projects eliminated through the external evaluation
- 11 projects approved
- range of funding: 50-200.000 €
- overall investment: 1.500.000 € (2003-2004)
- industries:

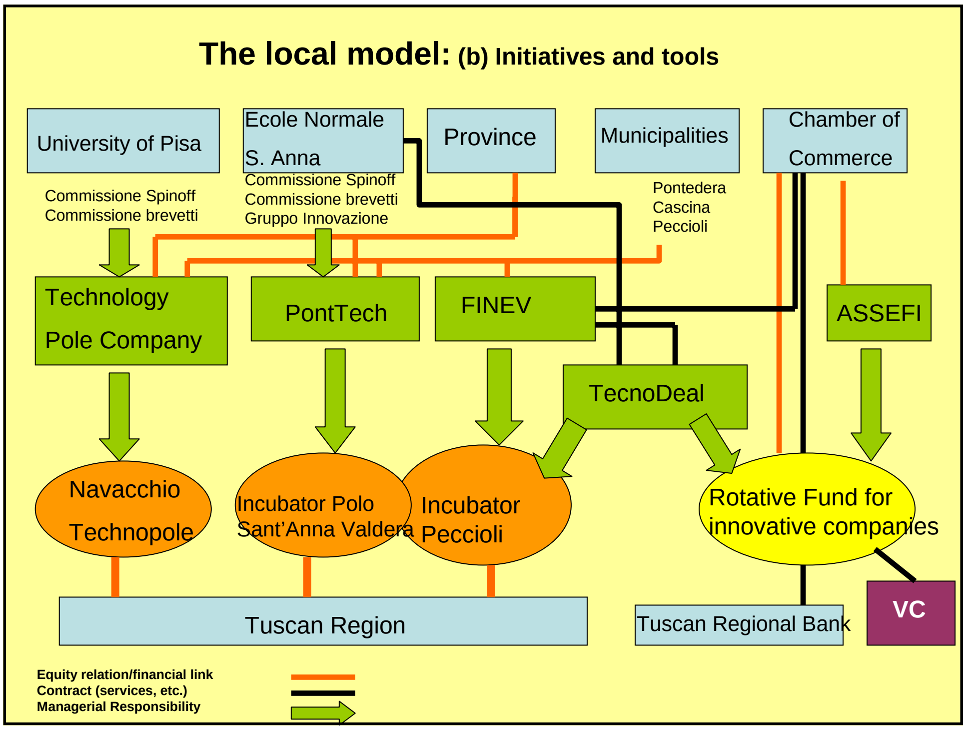
• biomedical tools *
• X ray devices *
• cristal components for laser machines *
• devices for colon diagnosys *
• ultrathin films for packaging *
• advanced robotic tools for manufacturing **
• Wi Fi networks design and implementation *
• design of systems-on-chip for mobile phone applications **
• electromagnetic diagnosis for TLC networks **
• medical devices for old people phisical deseases *
• design of electronic car components for the car industry **

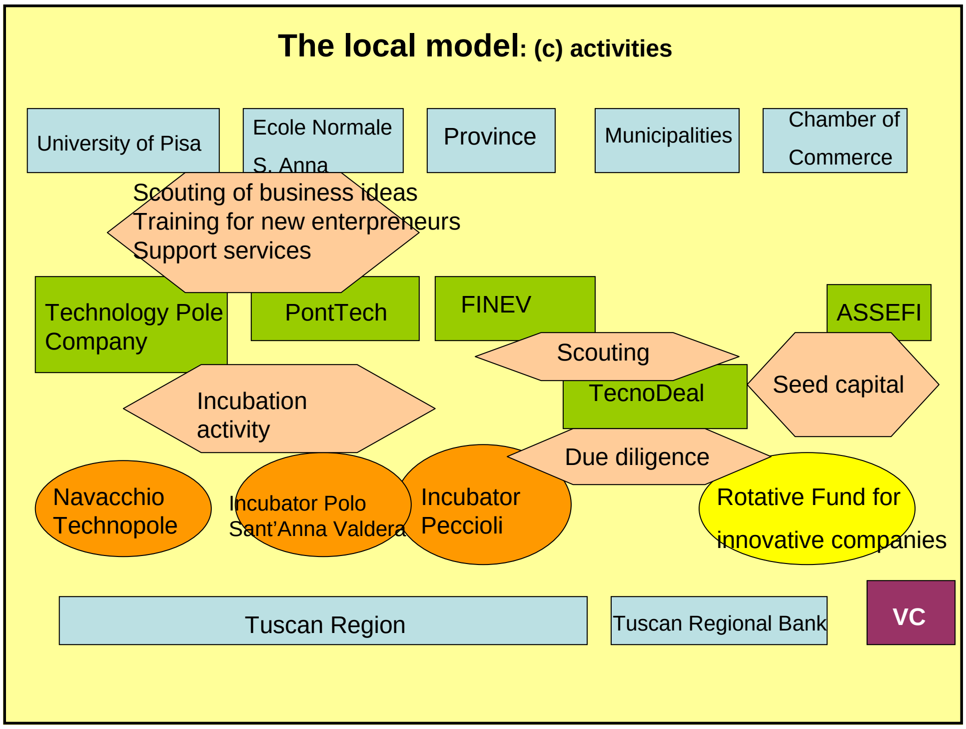
* = academic/research spin off　　** = industrial spin off

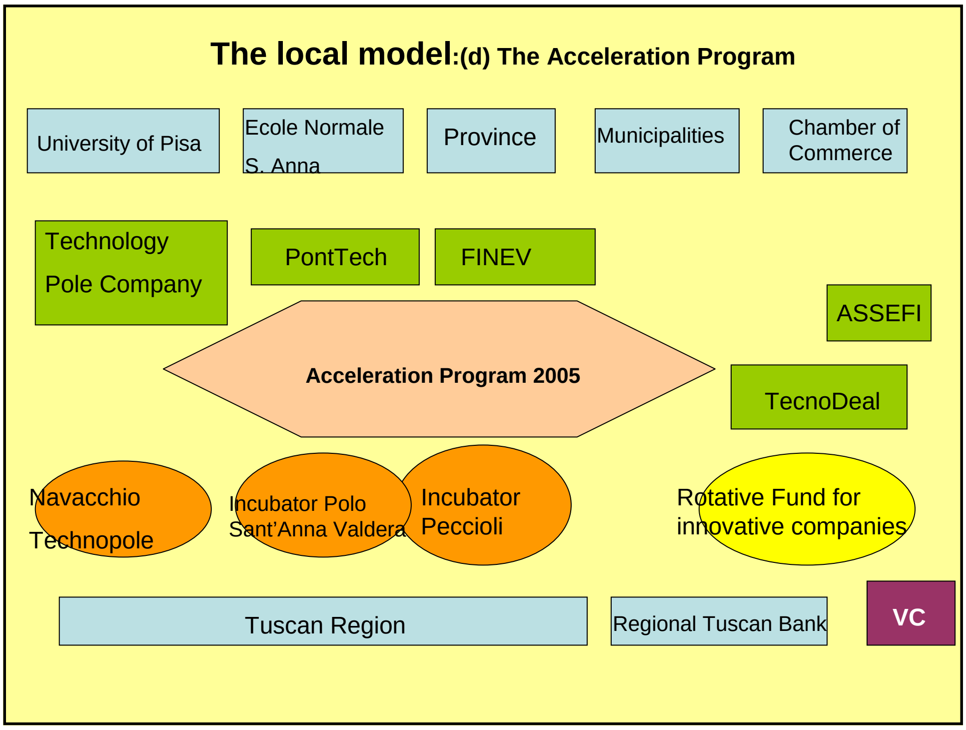

The local model for the development of new start ups: (a) key actors
University of Pisa
Ecole Normale S. Anna
Province
Municipalities
Chamber of Commerce
Spinoff Commission
Patent Commission
Spinoff Commission
Patent Commission
Pontedera
Cascina
Peccioli
Tuscan Region
Tuscan Regional Bank


The local model: (b) initiatives and tools
University of Pisa
Ecole Normale S. Anna
Province
Municipalities
Chamber of Commerce
Spinoff Commission
Patents Commission
Spinoff Commission
Patents Commission
Innovation Group
Pontedera
Cascina
Peccioli
Technology Pole Company
Navacchio Technopole
Tuscan Region
Tuscan Regional Bank

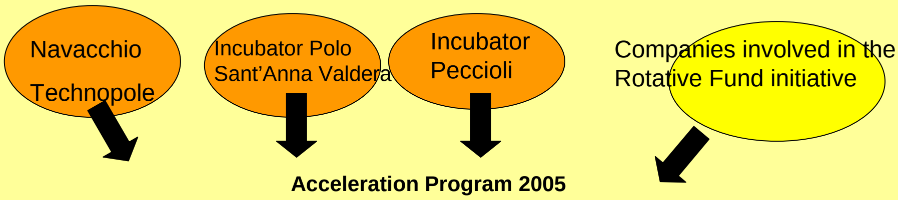

The local model: (b) initiatives and tools
University of Pisa
Ecole Normale S. Anna
Province
Municipalities
Chamber of Commerce
Commissione Spinoff
Commissione brevetti
Commissione Spinoff
Commissione brevetti
Gruppo Innovazione
Pontedera
Cascina
Peccioli
Technology Pole Company
PontTech
FINEV
TecnoDeal
Navacchio Technopole
Incubator Polo Sant'Anna Valdera
Incubator Peccioli
Tuscan Region
Tuscan Regional Bank


The local model: (b) Initiatives and tools
University of Pisa
Ecole Normale S. Anna
Province
Municipalities
Chamber of Commerce
Commissione Spinoff
Commissione brevetti
Commissione Spinoff
Commissione brevetti
Gruppo Innovazione
Pontedera
Cascina
Peccioli
Technology Pole Company
PontTech
FINEV
ASSEFI
TecnoDeal
Navacchio Technopole
Incubator Polo Sant'Anna Valdera
Incubator Peccioli
Rotative Fund for innovative companies
Tuscan Region
Tuscan Regional Bank
VC
Equity relation/financial link
Contract (services, etc.)
Managerial Responsibility


The local model: (c) activities
University of Pisa
Ecole Normale S. Anna
Province
Municipalities
Chamber of Commerce
Scouting of business ideas
Training for new enterpreneurs
Support services
Technology Pole Company
PontTech
FINEV
ASSEFI
Scouting
TecnoDeal
Seed capital
Incubation activity
Due diligence
Navacchio Technopole
Incubator Polo Sant'Anna Valdera
Incubator Peccioli
Rotative Fund for innovative companies
Tuscan Region
Tuscan Regional Bank
VC


The local model:(d) The Acceleration Program
University of Pisa
Ecole Normale S. Anna
Province
Municipalities
Chamber of Commerce
Technology Pole Company
PontTech
FINEV
ASSEFI
Acceleration Program 2005
TecnoDeal
Navacchio Technopole
Incubator Polo Sant'Anna Valdera
Incubator Peccioli
Rotative Fund for innovative companies
Tuscan Region
Regional Tuscan Bank
VC

The local model: (d) The acceleration Program



Acceleration Program 2005

- Club innovative companies/investment readyness training
- Commercial *Temporary manager*
- international development plan
- Meeting with VCs and big multinational companies

International Industrial Clustering

- A Global Value Chain Perspective

Victor B. Kreng, Ph.D.

Professor, Management School, NCKU, Chinese Taipei
Director, SME Research Center, NCKU, Chinese Taipei

1

"Today's economic map of the world is dominated by what I call clusters: critical masses - in one place - of unusual competitive success in particular fields."

Michael E. Porter
November-December 1998, HBR

-2

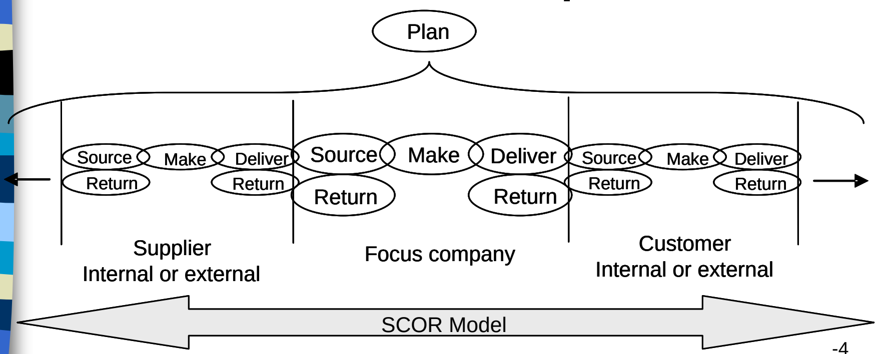
Environment

- Service and/or Mfg Sector
  - – No clear boundary
- Dynamic Competition
  - – No forever competitiveness
- Outsourcing
  - – No do-them-all in house
- Globalization
  - – No domestic company

-3

Scope of Value Chain

- **Industrial Clusters versus Virtual Corporation**



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Virtual Corporation

- An organization composed of several business partners sharing costs and resources for the production or utilization of a product or service
- Major attributes of a VC
  – Excellence, Utilization, Opportunism, Trust, Lack of borders, Technology , Adaptability to change,

-5

Industrial Clusters

- USA : Detroit Auto Cluster
  California Wine Cluster
  Silicon Valley Innovation Cluster
- TWN: PC and Peripherals
  Semi-Conductor Cluster
  TFT-LCD Cluster

-6

Characteristics

- Co-petition : Competition & Cooperation
- Industry Classification
- Business Environment
- Productivity
- Innovation
- Development

-7

Investment Opportunities

- Developing Economy
  - Labor and Natural Resources
- Middle-income Economy
  - Well-functioning Cluster
- Advanced Economy
  - Cluster Upgrading

-8

Promoting Industrial Clusters

- Improving Education and Skill Level
- Managing Human Capital
- Accessing Information & Knowledge
- Building Technology Capacity
- Accessing Equity Market
- Investing Cluster-specific Asset

-9

"A cluster allows each member to benefit as if it had greater scale or as if It had joined with others without sacrificing its flexibility."

Michael E. Porter
November-December 1998, HBR

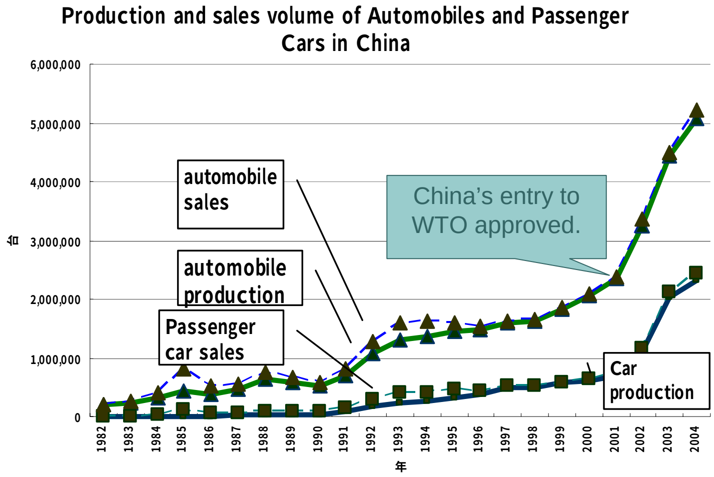
-10

Automobile Industry Clusters in China

Tomoo Marukawa (University of Tokyo)

1. *Introduction*
2. *The Theoretical Framework*
3. *Trends of Dispersion and Concentration of the Chinese Automobile Industry*
4. *Case Studies of the Carmaker-Supplier Relationship*
5. *A Quantitative Analysis of the Supply Structure of Car Components*
6. *Concluding Observations: New Automobile Industry Clusters*

China’s automobile production has doubled during the two years after China’s entry to WTO.



One of the reasons of the rapid progress of China’s automobile industry is the growth of supplier networks.

Casual observation tells us that:

- Large state-owned automobile manufacturers have a full set of suppliers gathered around.
- Joint venture car factories have supplier clusters nearby their plants.
- Ruian, Wenzhou city, has no less than 1500 small and mid-sized component manufacturers specialized in spare parts production.

The Theoretical Framework

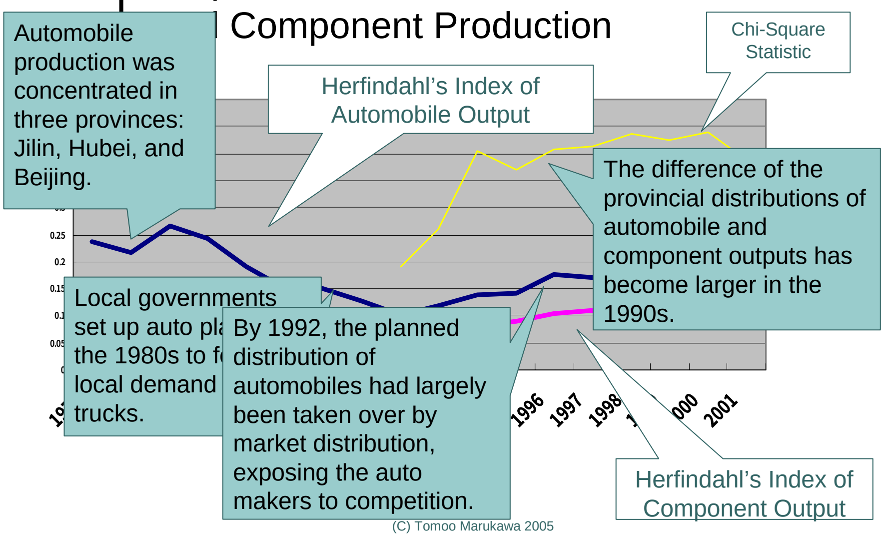
- Since automobile production has large scale economy and transportation costs of automobiles are low, automobile production will concentrate to some regions.
- The transportation costs of components, however, are not necessarily low. Automobile manufacturers require frequent, just-in-time deliveries.
- On the other hand, there is scale economy in most kinds of automobile component production.

- Hence, suppliers face the trade-off between scale economy and transportation cost.
- The supplier's decision whether to establish a new plant nearby the auto plant or not depends on the comparison of the cost of sacrificing scale economy and the transportation cost of supplying the auto plant from other existing plants.
- Therefore, the increase of auto production at a certain place will attract component production. As the scale of component production increases, it may even supply auto makers in other places.

Trends of Dispersion and Concentration of the Chinese Automobile Industry

- The regional distribution of automobile and component production in China is influenced not only by economic motives but also by government planning.

Dispersion/Concentration of Automobile
Component Production



- But this fact does not run contrary to our theory. In fact, automobile production in Shanghai has stimulated component production in neighboring provinces, namely, Jiangsu and Zhejiang, which have little automobile production. Shanghai, Jiangsu, and Zhejiang account for 46 percent of national component production.

Case Studies of the Carmaker-Supplier Relationship

Figure 3A Supply structure of seats

Name of supplier	Type of firm	City	SVW	SGM	DCAC	BJC	FAWVW	Hongqi	Xiali	Changan Suzuki	Fengshen	Guangzhou Honda	Qirui
Shanghai Yanfeng Johnson Controls	JCI (USA). Member of SAIC	Shanghai	■	■									
Shanghai Vehicle Awning and Cushioned Seat Factory	State owned	Shanghai	■	■									
Wuhan Yunhe Auto Sear Co.	NA	Wuhan			■								
Wuhan Jiangshen Auto Trimming Co.	JV with SAIC	Wuhan			■						■		■
Beijing Johnson Controls	JV with JCI (USA)	Beijing				■							
Fawer Johnson Controls Automotive System Co.	JV with JCI (USA)	Changchun					■	■					
Tianjin Huafeng Auto Trimming Co.	JV with Araco (Japan)	Tianjin							■				
Chongqing Lear Changan Co.	JV with Lear (USA)	Chongqi...								■			
Chongqing Yanfeng Co.	JV with Hsin Chong (Taiwan)									■			

Major carmakers are buying solely from the supplier located in the same city.

Large carmakers are buying mainly from local suppliers, but at the same time they buy from other suppliers located outside of the city. This is due to “double-sourcing.”

Figure 3B Supply structure of Radiators

Name of supplier	Type of firm		v	M	C			qi	i	Changan Suzuki	Fengshen	Guangzhou Honda	Qirui
Auto Parts Factory, Shanghai Hezhong Automotive Parts Co.,	State owned (SAIC)	Shanghai	■	■									■
Shijiazhuang Aluminium Radiator Co.	NA	Shijiazhuang	■				■						
Dongfeng Radiator Co.	State owned (DFM)	Shiyan			■								
United Aluminium Radiator Co.	JV with Visteon (USA) (FAW)	Changchun					■	■					
Tianjin Automotive Radiator Co.	State owned (Tianjin)	Tianjin							■				
Yonghong Machinery Plant, Guizhou Aviation Automobile Parts Co.	State owned	Guiyang	■				■						

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Shanghai Koito supplies lamps to almost all of the carmakers.

Figure 3C Supply structure of Lamps

Name of supplier	Type of firm	City	SVW	SGM	DCAC	BJC	FAWVW	Hongqi	Xiali	Changan Suzuki	Fengshen	Guangzhou Honda	Qirui
Shanghai Koito Automotive Lamp Co.	JV with Koito (Japan) (SAIC)	Shanghai	■	■		■	■	■	■	■	■	■	
Shanghai Pudong Lamp Co.	NA	Shanghai	■										
Shanghai Guangdian Hella Auto Lamp	JV with Hella (Ger)	Shanghai	■										■
Hubei Valeo Lamp Co.	JV with Valeo (Fra)	Wuhan			■		■			■			
Beijing Beideng Auto Lamp Co.	Limitied liability	Beijing				■							
Changchun Hella Auto Lamp	JV with Hella (Ger)	Changchun	■				■	■					
Beijing Meixing Automobile Lighting Co.	NA	Beijing							■				
Tianjin Automotive Lamp Factory	Collective	Tianjin				■			■				
Taixing Lamps Plant	NA	Taixing							■				

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A Quantitative Analysis of the Supply Structure of Car Components

- Using a logit model, the supply structure of 11 carmakers and 478 suppliers was analyzed. The estimation result is reported in Table 3 of my paper.
- The coefficient of the distance between the supplier and the carmaker is significantly negative.
- Suppliers with higher share of foreign capital have advantage in getting orders.
- Coming from the same country with the carmaker is advantageous in getting orders.

Table 3 Logit analysis of supply relations between the suppliers and the 11 carmakers

independent variables	Model 1		Model 2		Model 3		Model 4	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	-0.66	-5.74	-0.77	-8.37	-0.78	-8.93	-0.80	-9.88
Attributes of Suppliers								
German-invested	0.31	1.95	0.40	2.20				
American-invested	0.32	2.44	0.49	3.27				
Japanese-invested	0.38	2.63	0.43	2.65				
Taiwan-invested	-0.40	-1.20	-0.38	-1.24				
Hongkong-invested	0.44	2.12	0.44	2.10				
French-invested	0.17	0.68	0.16	0.64				
Share of Foreign Capital Ownership			-0.24	-1.16			0.29	2.35
State owned enterprise	-0.02	-0.16	-0.07	-0.72				
Total Asset Value	7.5E-07	1.23			1.4E-06	2.46		
Number of employees								
Location								
Shanghai	0.21	1.87						
Hubei	-0.35	-2.45						
Tianjin	-0.81	-5.05						
Jiangsu	-0.07	-0.47						
Jilin	-0.10	-0.61						
Membership of enterprise group								
SAIC			0.65	4.91				
DFM			-0.46	-2.10				
FAW			-0.23	-1.03				
Tianjin			-0.83	-4.16				
Relationship of Supplier and Carmaker								
Same Nationality with the Carmaker					1.11	8.22		
Distance between the Supplier and Carmaker	-7.9E-04	-15.96	-7.8E-04	-17.56	-7.8E-04	-15.80	-7.7E-04	-17.48
Production Volume of Carmaker	6.4E-06	10.95	6.6E-06	12.65	6.5E-06	11.1295	6.4E-06	12.60
Number of Samples	4081		5236		4081		5236	
Log likelihood	-1895.43		-2369.56		-1899.459		-2407.69	
LR Statistics	515.27		641.56		507.21616		565.28	
McFadden R^2	0.12		0.12		0.12		0.11	

stribution of Car Suppliers

SVW's suppliers are more scattered than those of SGM. The reasons for this are: SVW's policy of "double-sourcing," and government intervention.

r of suppliers)

SVW		SGM		DCAC		FAW-VW	
Shanghai	89	Shanghai	57	Hubei	48	Shanghai	41
Jiangsu	25	Jiangsu	14	Shanghai	26	Jilin	34
Zhejiang	15	Zhejiang	12	Jiangsu	10	Jiangsu	16
Guizhou	12	Other	12	Zhejiang	8	Zhejiang	15
Hubei	10					Hubei	10
Jilin	7					H[illegible]	[illegible]
Other	43						

DCAC is located in Wuhan, 1300 kilometers away from Shanghai, and yet it has many suppliers in Shanghai, Jiangsu and Zhejiang.

FAW-VW is 2300 kilometers away from Shanghai. But it also has many suppliers in the Yangze River Delta.

Regional Distribution of Guangzhou Honda's Suppliers

Guangdong	51
Shanghai	17
Tianjin	10
Jiangsu	9
Zhejiang	6
Others	16

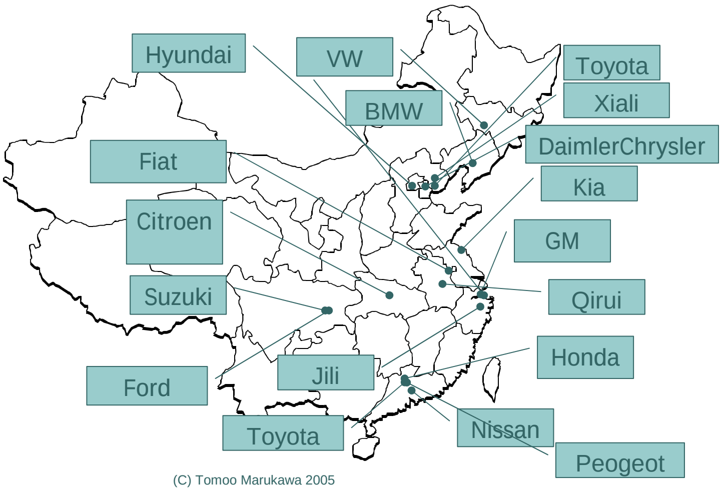
Guangzhou Honda also has quite a few suppliers around Shanghai.

- These figures suggest that the suppliers of the Yangzi River Delta, namely Shanghai, Jiangsu and Zhejiang, which started their development with the localization of Shanghai VW, are now enjoying scale economy, which makes them competitive enough to supply remote carmakers.

Then, are the newcomers in car production attracted to the places where they can have easy access to component supply?

- The answer is no. Recent large-scale investments made by foreign carmakers in China have settled down in regions outside of the Yangze River Delta: Toyota went to Tianjin, and then to Guangzhou. Nissan went to Guangzhou and Hubei. Hyundai went to Beijing, and Ford went to Chongqing.

Guangdong, Chongqing, and Changchun are emerging as new car component clusters.



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- The major carmakers seem to think that suppliers will establish plants to wherever the carmakers set up new factories. In addition, they think that the disadvantage of sharing the local market of Yangze River Delta with precedent carmakers, SVW and SGM, is larger than the advantage of the region in procuring components.

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Concluding Observations: New Automobile Industry Clusters

- Japanese carmakers did attract suppliers around their plants: at least 21 Toyota-related suppliers in Tianjin, more than 40 Japanese-invested suppliers in Guangdong, where Honda, Nissan and Toyota gather.
- Suppliers are also clustered around Suzuki and Ford in the inland city of Chongqing.

Japanese carmakers' way of purchasing, however, may become an obstacle for Guangdong to become a competitive parts cluster.

- Japanese carmakers buy only from the supplier that have participated in the development of a new model.
- Hence, there are little connection between the supplier networks of Honda, Nissan, and Toyota in Guangdong.
- Among the 23 suppliers of Honda, only one supplies Toyota, and only two supplies Nissan.

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- By contrast, among the 86 suppliers of Shanghai GM, 75 also supply Shanghai VW.
- GM made use of the supplier network of SVW, but Japanese carmakers have brought in new suppliers for their own use to Guangdong.
- We are about to see the competition between several automobile industry clusters in China, in which the competitiveness of carmakers and parts suppliers are intertwined.

Small and Medium Enterprises in Singapore and Strategies for Regional Cooperation and Integration: Policy Lapses, Lessons Learnt and Challenges Ahead*

*** A presentation at the APEC Symposium On Industrial Clustering for SMEs", organized by The Small and Medium Enterprise Administration, The ministry of Economic Affairs, Chinese Taipei, 8 – 9 March 2005, International Convention Center, Chinese Taipei.**

Dr. Tan Khee Giap

Head, ASEAN Economies Monitoring Unit,

Economic Growth Center,

Nanyang Technological University, Singapore

Visiting Senior Fellow, Institute of South East Asian Studies (ISEAS), Singapore

Scope and Thrust of the Presentation

- Competitiveness ranking of ASEAN 10 + 1.
- The continued relevance of the export-led growth model for ASEAN-10 economies
- Five basic tenets of the Singapore economy.
- The plight and potential of SMEs in Singapore: Policy lapses, lessons learnt and challenges ahead.
- A balanced economic ecol system amongst SMEs, SOEs and MNCS.
- Singapore's problems: Where we stand vis-à-vis regional economies?
- Regional integration effort and strategies forward from international and domestic fronts.
- On further cooperation and integration of ASEAN-10 through SMEs and cross-investment: Market risks, challenges and opportunities.
- How ASEAN-10 can be and should be like 30 years from now?
- Performances of East Asian economies, 2001-2010

Primary Concerns of ASEAN-10

- The startling vulnerability of ASEAN, both for market and transition economies, in the 1997 financial turmoil.
- Fresh attractiveness to and fierce competition posed by large emerging economies such as India and China since late 1990s
- ASEAN economies risked being marginalized unless pooled together and plugged in to regional global economies.
- How to promote economic resiliency, enhance competitiveness and develop a balanced economic ecol system?
- Strategies forward for closer cooperation and integration within ASEAN and into Asia growth locomotive

Fundamental Objectives For ASEAN-10

- Classical economists evaluate competitiveness amongst nations based on factors of production such as land, capital, natural resources and labor.
- Although a liberal trade and investment environment for international linkages are paramount, it is also widely acknowledge that a country's competitiveness is more than just a set of "hard" quantitative macroeconomics aggregates.
- Attraction of FDIs and flourishing of SMEs must also cope with other "soft" attributes such as social, political, cultural, governmental, environment, institutional and educational dimensions of a nation
- WTO, through multilateral, regional and bilateral FTAs, attempts to push tariffs down and open markets further.
- Vital for ASEAN-10 to cope with intensifying regional competition vis-à-vis a new but not necessarily lesser role of the government.

Motivations and Common Strategies for ASEAN-10

- No longer be that of restoring ASEAN-10 to pre-crisis growth level. Focus has shifted to discovering new competitive base.
- Core motivations must be to identify, release and exploit the resiliency of the local economy based on market oriented-strategies
- Paramount to have a good understanding of the regional economies' current and future competitiveness landscape.
- To ascertain the ability, capability and cooperation amongst of ASEAN-10 as an effective economic community.

Definitions and Data Sources

Competitiveness Components:

- Economic environment –national accounts, international transactions & foreign investments (18 criteria)
- Political environment – government finance, government policies, institutional framework, standards and regulations. (43 criteria)
- Business Environment – financial markets, labor market & productivity (22 criteria)
- Social Environment –basic infrastructure, technological infrastructure & quality of life. (39 criteria)
- 122 criteria, consist of 51 series of quantitative data and 71 series of qualitative data, sources from International Financial Statistics,IMF, ASEAN Secretariat & Political & Economic Risk Consultancy Ltd (PERC).

Methodological Approach Adopted

- The basis for the ranking is the standardized value (STD),and we first compute the 10-country average for each criteria following which the standard deviation is calculated using the formula:

  $S = \sqrt{(\sum(x - x)^2 / N}$

- Following which STD is computed, by subtracting the 10-country average from a country's original value and then dividing the result by the standard deviation as follow:

  STD value = $(x - x) / S$

- Note that sub-factor rankings are the average of the STD values of all the ranked criteria which make up each sub-factor. This average is found by dividing the sum of the STD values by the number of criteria in each sub-sector. This enables us to "lock" the weight of sub sectors independently of the number of criteria they contain.

Empirical Findings: ASEAN-9 Competitiveness Rankings

Country	Score	Rank
Singapore	2.02	1
Malaysia	3.55	2
Thailand	3.61	3
Philippines	4.59	4
Vietnam	5.23	5
Indonesia	5.35	6
Cambodia	5.74	7
Myanmar	5.84	8
Lao PDR	5.93	9

Empirical Findings: ASEAN 9+1 Competitiveness Rankings

Country	Score	Rank
Singapore	2.34	1
Malaysia	4.03	2
China	4.12	3
Thailand	4.13	4
Philippines	5.24	5
Vietnam	5.95	6
Indonesia	6.11	7
Cambodia	6.50	8
Myanmar	6.62	9
Lao PDR	6.71	10

Empirical Findings: ASEAN 9 +1 Competitiveness Simulations

- A series of competitiveness simulations were conducted on each country by taking the weakest 20% of our competitiveness criteria, and replacing the actual values with the 10-country average, i.e. one country improves and the rest remained unchanged or ceteris paribus, and see how these improvement helped augment the country's competitiveness ranking.
- Upon simulations we found

Singapore: from 1 (2.34) to 1 (2.21);

Malaysia: from2 (4.03) to 2 (3.67)

China: from 3 (4.12) to 2 (3.48)

Thailand: from 4 (4.13) to 2 (3.68)

Philippines: from 5 (5.24) to 5 (4.79)

Vietnam: from 6 (5.95) to 6 (5.46)

Indonesia: from 7 (6.11) to 5 (5.31)

Cambodia: from 8 (6.50) to 5 (5.32)

Myanmar: from 9 (6.62) to 5 (5.49)

Lao PDR: from 10 (6.71) to 5 (5.39)

Policy Implications From Model Simulations

Interesting implications based on our simulations:

- The challenge for Singapore and Malaysia is to stay on top!
- China can catch up and overtake Malaysia, even if Malaysia improves 20% of its weakest areas.
- Thailand follows closely behind China and Malaysia after improving 20% of its weakest criteria
- Philippines & Vietnam retain their ranking even after 20% simulated improvement of the weakest criteria, implies they need to overhaul their existing system and institute comprehensive reform before they can improve further
- Weak economies like Indonesia, Cambodia, Myanmar and Lao PDR managed to jump a few ranks upon transcending their inherent limitations shows potential for further improvement**.**

The Relevance of the Export-led Growth Model: Textbook arguments versus pragmatic considerations

- “If we have done it so wrong, we would not have been what we are today” Mr. Lee Kuan Yew commented recently on Singapore.However, the Asian financial crisis, which affected some ASEAN members more seriously than others, suggests that we have made mistakes along the way and need to be reminded that:
- 1. Macro economy policies are not laboratory experiments, drastic fundamental policy changes will always have unintended outcomes and unexpected consequences, but reform changes we must push on.
- 2. Economists have to be more humble, pay more attention to development of international markets and be more patient when observing turns or trends.
- 3. Government’s role is to be renew and strengthen but not weaken during economic restructuring or transitional period
- 4.In the absent of alternative model, the pragmatic way forward is still export-oriented strategies first and expand domestic demand later, constant economic restructuring but not system overhaul.
- 5. Returning to high and sustained gdp growth, build up a good level of foreign exchange reserves, stabilize value of the local currency, maintaining budgetary discipline, scale down SOEs via-a-vis SMEs to absorb unemployment and restore efficiency and resource misallocation.

On Five Basic Tenets of the Singapore Economy: The government is no magician!

Tenet 1: Singapore will always be more rather than less dependent on external demand, her small size led to limited scope for domestic demand unless expand the population to 8 millions over decades.

Tenet 2: Singapore has no natural endowment, the only resources she can create are financial and human capital, that is, continuing wealth accumulation and recruitment of foreign experts.

Tenet 3: Policy formulations, be it taxes, labor, infrastructure, incentives or education, will always aim at the two economies, namely, the international economy and the domestic economy.

Tenet 4: Housing space, land use, transportation, water and electricity supply, while can be made more efficient will increasingly become more costly unless being subsidized.

Tenet 5: Since the East Asian financial crisis in 1997, Singapore is deemed to have moved into an era of economic discontinuity where future potential growth is likely to be more volatile as compared to the era of prolong growth in 1986-1997

The Plight and Potential of SMEs in Singapore

- Contributions of SMEs to the economy as of 1999:
- 89% of total establishments; 52% of employment; 30% of the total value added; 24% of the total sales.
- Value-added contributions of SMEs by sectors:
- SMEs accounted for 16% of value-added in manufacturing; 43% in commerce and 34% in services
- Employment contributions of SMEs by sectors:
- SMEs accounted for 35% in manufacturing; 70% in commerce and 51% in services
- Value-added per workers by sectors:
- Productivity of SMEs is only 315 of others in manufacturing, 33& of others in commerce and 48% of others in services
- It is ironic that while value added to the economy and productivity per worker of SMEs is far lower than other establishments, typically its employment contributions are relatively large. This would has significant political implications which if not deal with satisfactorily and sensitively can become a socio-political focus point.

On SMEs Development: Policy Lapses

- Policy to attract MNCs to promote economic growth and job creation as dictated by political consideration and economics circumstances, thus created favorable environment which disadvantaged operation for SMEs given the non-level playing field.
- Recruiting the best of the cohort each year into the public services with better remuneration and more stable job security in competition with private sector creamed away potential entrepreneurs and stifle development of SMEs.
- Given the relative low education, technical content and management skill of labor force then in 1960s, 1970s and 1980s, GLCs or SOEs intervened to retain industries which are of "strategic interests" such as banking, ports, air and sea liners, since SMEs are perceived to be unlikely to deliver such objectives. However, such well intended initiatives grew with bureaucratic rules which snow balled into wholesale dominance of GLCs and dwarfed development of SMEs

On SMEs Development: Lessons Learnt

- The dilemma of SMEs in Singapore is indeed a valuable lesson for other ASEAN authorities:
- 1. While as an strategy, an economy needs to leverage on MNCs to deliver the basic growth in the early stage for subsequent economic take-off, over promotion of MNCs or rather neglect of SMEs can cause socio-political pressure.
- 2. As the economy matures and moving up the technological ladder, every additional dollar brought in by future FDIs and PIs will create lesser jobs then they used to be, yet SMEs increasingly are to be depended upon for future job creation.
- 3. Instead of using GLCs to "replace" SMEs as in the case of Singapore, transition economies in particular should consider using SMEs to replace SOEs as part of economic restructuring to reform SOBs and employment creation.

On SMEs Development: Challenges Ahead

- Promoting SMEs development in Singapore is very challenging and may be non-reversible unless out-of-the-box measures or policies u-turns are being carried out.
- It may not be easy to persuade or convinced the brightest and the most capable Singaporeans who are now senior civil servants and top professionals to be entrepreneurs. Even ordinary Singaporeans who are used to predictable and steadily improving living standard are likely to venture into business and take calculated risks.
- As Singapore moves into era of growth discontinuity, full employment may no longer be reasonably assumed, yet SMEs, which the authorities try hard to revitalize, remains the best source of employment engagement.
- The current support system to SMEs is far too dispersed to be effective, SMEs has to deal with EDB, TDB, IDA, SPRING, EPC. A*STAR, JTC, STB and SITF, we hence proposed (see The IFER Report 2002) for a one-stop government agency for SMEs

Latest Reform Initiatives to Revitalize SMEs

- Under the "SME 21: Positioning Singapore for the Twenty-first Century" released in 2001and a series of policy measures adopted recently, strategic goals were stated and major initiatives to revitalize SMES include:
- 1.Ensuring financial infrastructure for raising working capital through both government and private sector means.
- 2. Effective technology diffusion through Technology Network (TechNet) and the Skill Development Fund (SDF).
- 3 Access to skill labor through National Skill Recognition System (NSRS)
- 4. Expanding marketing capabilities through The International Enterprise Singapore.
- 5. The new NUS-Spring Center to assist SMEs
- 6. Business fusion program for SMEs
- 7. Promoting MNCc-SMEs linkages
- 8. Ensuring level playing filed between GLCs and SMEs
- 9. Encouraging GLCs to go regional
- 10.Easing rigid rules and regulations for SMEs
- 11. Building Singapore as an SME Hub
- 12.Appointed a Minister for Entrepreneurship to engage mind-set change

Singapore's Problems vis-a-vis Regional Economies

- 1."Competition is not as polite as inviting guests for lunch!" : On International front, just look at cases of Singapore/Malaysia ports tussle; Singapore/Hong Kong manufacturing restructuring; "storm over the tea cup" in Singapore/Suzhou,China;
- 2."The unraveling of the Roaring Nineties came quickly…and it made a reinterpretation of the decade even more compelling" : Government should play an important role not only in correcting market failures and limitations but also in working towards greater social justice, rather than the minimalist role for the state (see Stiglitz 2003).
- 3."The state invisible hands, while in pursuit of honest self interests unintentionally harmed public goods :On Singapore's total cost structure, be it business costs, land and housing cost, costs of living, transportation costs or labor costs: Civil servants' invisible hands, while in honest pursuit of self interests to do a "good" job, unintentionally harmed the public interests, delivering unintended policy outcome from correctly formulated policy objectives.
- 4."Obsession with competitiveness is both wrong and dangerous": Should not be too complacent with the well placed competitiveness by most international indices including the IPS-NTU ASEAN 9 + 1 Competitiveness raking (see Tan 2004), but the gap is fast narrowing amongst our competitors (see Krugman 1998).

Key Strategy Forward: On International Front

- "We shall always negotiate from strength but not from weaknesses, may I remind my honorable friend that this lady is not for turning!" : In further internationalization of the Singapore Inc., wings of bilateral FTAs, TLCs and GIC should flap steadfast against tide of foreign protectionism or even objection so long as it is of mutual interests to both Singapore and the host.
- Micro manage, attract and host international agencies and multilateral institutions to physically locate or set up branches in Singapore to enhance Singapore's international relevance
- Retaining our longstanding regional competitive edge, maintaining our multi-cultural and multi-language mix, avoid side issues and debate on semantics when engaging and integrate with regional economies.

Key Strategies Forward: On Domestic Front

- A careful analysis on the self-inflicted problem and its policy dilemma: On surplus accumulation: sources, timing, and target quantum; On surplus management: returns, strategies and accountability; On surplus utilization: when, to whom and how?
- Singapore has been running structural budget surpluses and grew above potential output for almost four decades through the era of continued growth prosperity. In the era of growth discontinuity: Smaller surpluses are to be expected as future recession may be prolonged and deep, structural deficit caused by aging population and structural unemployment can emerge if not careful. SMEs as a vehicle for job creation should be enhanced.
- How the nature of public services evolve, how public/private sector employment mix changes, and how the local/foreign employment mix rotate require careful analysis.
- Putting statutory boards' mega surpluses under the microscope, impose controls and review surplus retention ratio could bring intangible benefits beyond the dollars and cents saved.

On Markets Risks: The Regional Socio-political Landscape.

- Being competitive than others is meaningless if we do not capitalize on our strength or advantages to value-add on their less efficient systems. The startling vulnerability of ASEAN, for both market and transition economies in the 1997 financial turmoil revealed that weak government governance is amongst the major causes.
- While emerging markets such as China and India are large and ready since the late 1990s, they tend to be fiercely competitive. Neighboring ASEAN economies may appear less attractive, but could turn out to be easier to do deals with as we are more familiar with one another.
- Coping with non-transparent foreign systems and be innovative in "fixing deals" is an art itself. Thus shading away the "government" element amongst ASEAN dealings may enable a more flexible and nimble business approach.

On Challenges: The Right Partnership And Coping With Foreign Systems

- A majority stake in partnerships are unlikely to be sustainable especially if it is successful, and attached with it a bigger-risk premium and potential national friction.
- A substantial minority stake through value-add in management efficiency, system planning, seed capital funding and technology injection are more manageable and realistic for more developed ASEAN members.
- Joint ventures with foreign governments, state-owned enterprises or private sector interests are important considerations, which vary from country to country, identifying a strategic foreign partner requires networking through "inside-track" approach.
- Product development, branding and marketing partnerships in cross-border SMEs cooperation typically require a medium-term investment time frame to yield dividends, having a deep pocket thus helps.

On Opportunities, Risk-taking and Value-creation of SMEs

- For most developing economies in East Asia, the robust GDP growth for 2004 has been the strongest performance growth since the 1997-1998 financial crisis. More than six years after the crisis, transportation-infrastructure investments, agricultural produce, food processing, tourism and commerce services, are once again an important development sector of these economies.
- For the more developed economies of ASEAN such as Malaysia and Thailand where traditional transportation infrastructure are still inefficient and modern train transportation which were delayed or aborted after the financial crisis, we are beginning to see sustained picking up of investment demand in this sector, and hence tremendous opportunities to ride on the steady economic rebound.
- As Indonesia stabilizes from the political fallouts and social upheaval, the return to traditional agricultural produce and potential of food processing cannot be ignored, given her large population base.
- Likewise for transitional economies such as Vietnam Cambodia and Laos, export of agricultural produce, food processing, tourism services can be potentially attractive. Labor intensive-low- tech export industries such as garments, electronics assembly could be further developed
- Having seen steady average gdp growth of 7% per annum over the past decade, coastal provinces of China have achieved a good level of development and industrial clusters to support the further growth of township enterprises (TEs) as SOEs are privatized.

Leadership in Recent FTAs Initiatives

- An emerging market of more than 500 million people, ASEAN Free Trade Area (AFTA) has been further intensified and extended to regional and bilateral free trade agreements (FTAs)
- China-ASEAN Free Trade Area (proposed in Nov.2001), Japan-ASEAN free-trade Area (proposed in Jan 2002), USA-ASEAN Free Trade Area (proposed in Mar.2002) and possibly proposed European-ASEAN Free Trade Area in 2005 are serious strategies by major economic powerhouses to stay engaged with ASEAN.
- Bilateral FTAs are not threats to the multilateral trading system, it can be viewed as a second-best solution. Since 1995, more than 150 FTAs in goods and/or services have been proposed of which 100 had been notified to WTO. Bilateral FTAs as a new measure of close economic cooperation between economic entities alongside or in lieu of the traditional military and political pact.
- Establishing an ASEAN Economic Community by 2020 as envisaged in November 2002 by SM Goh Chok Tong of Singapore. Leadership of Singapore in bilateral FTA with Japan, New Zealand, Australia, USA, Jordan, Korea, Chile, India, China and turkey can serve as useful platform for GLCs to regionalize.
- More ASEAN members must venture out to actively seek bilateral FTAs initiatives to immediately further plugged into the global trading system.

Policy Recommendations for Developing SMEs in ASEAN-10

- Cross-investment amongst more developed ASEAN members in their production reallocation process to benefit from lower labor cost and overcome narrowing profit margin, SMEs cam be one of the participating vehicles.
- The real potential of SMEs lie in the up stream activities of product development, and down stream activities of branding and marketing. Cross-border cooperation amongst SMEs of ASEAN based on comparative strength should be actively exploited.
- Agricultural produces and food processing for export, though not glamorous, but an profitable and viable options based cross-border comparative advantage and division of labor amongst nations.
- Promoting widespread education as a social leveling device, channel for income redistribution and skill upgrading mechanism would be crucial to the formation of middle class and hence potential source of entrepreneurs for SMEs .
- Current inefficiency in public services in governments and legal infra-structure imperfection may well be the opportunities for SMEs to seized upon and grow.
- Export-oriented strategies through FDIs may have to be the initial growth strategy to gather resources for reforming SOEs, SOBs and SMEs in transition economies.
- ASEAN members should set-up a one-stop government agency to coordinate and promote SME development

Some Worrisome Trends Confronting Asian Economies

- The elevation of Chinese Taipei position in the overall strategic paradigm where she becomes an important pawn in the overall Asian Pacific framework of the US, if not properly handled, can seriously upset China's growth momentum and East Asia stability.
- The trans-pacific imbalances caused by growing and unsustainable twin-deficits of the USA can pose a serious pressure to the greenback. A us dollar crisis triggered by Asian central banks looking elsewhere for alternative investments of their foreign exchange reserves, thus leading to Asian currencies appreciation can disrupt the export momentum of trade-oriented economies.
- Asian economies need to swiftly reduce inefficient state-owned enterprises and returning greater role and buoyancy to private sector entrepreneurs. Eight years after the 1997 East Asian financial crisis, political and economic reform inertia due to cronyism, nepotism, poor corporate governance, high indebtedness and weak budgetary discipline are yet to be significantly tackled.
- Given the history of enmity, rivalry and uneven distribution of power, Asian economies are not yet ready of an integrated Asian Economic Community (AEC), neither were they prepared to make concrete adjustments and policy changes required for successful implementation of regional arrangements.

Economic Forecasts of East Asian Economies

	2001 / 2002 / 2003 / 2004 / 2005	2001 – 2010
China	7% / 8% / 8.5% / 9.5% / 9%	7 %-9%
Hong Kong	-0.3% / 1.5% / 3% / 5% / 3%	2% - 4%
Tai wan	-2.7% / 3% / 4% / 5% / 4%	2% - 5%
Japan	-0.5% / -0.5%/ 2.5%/ 3% / 2.5%	2 %
Korea	7.5% / 6% / 6% / 5% / 4%	5% - 7%
Indonesia	4.5% / 2.5% / 4.5% / 5%/ 5%	3% - 5%
Malaysia	0.4% / 4% / 5.3 % / 5.5%/ 5%	5% -7%
Philippines	3.5% / 4% / 4% / 4% / 3%	2.5%- 4.5%
Singapore	-2.2% / 2.2%/ 1.1% / 8.5% /4%	3% - 5%
Thailand	4% / 5% / 6% / 6% / 5%	5% - 7%

How ASEAN-10 Can and Should Be Like 30 Years From Now?

- More cosmopolitan, vibrant and integrated as a effective regional entity through her potentially rich human resource and diverse cultural background, currently ASEAN is still too loose and in sufficient command of English as a business and working language amongst the 500 million population.
- More internationalized and risk-taking for ASEAN governments into Asia growth locomotives to say the least, currently still too inward looking and lack global perspective.
- More confident and ambitious in terms of future economic and political outlook, currently still too doubting, humble and pessimistic.
- More engaging in global trade and services, currently ASEAN governments are still too passive, “well behaved” and not “pushy” enough to plug into the global system.
- A more vibrant for ASEAN as a economic entity, currently still far too regulated and too state-control for transitional economies in particular, not enough private sector participation.
- A more open society for ASEAN community, currently still too conforming, too harsh and lack tolerance for dissent.

References

- Paul, Krugman (1998), “Competitiveness: A Dangerous Obsession”, in Pop International, published by The MIT Press, USA
- Joseph, E Stiglitz (2003), “The Roaring Nineties”, published by the Penguin Group, England, UK
- Khee Giap, Tan (2004) “The IPS-NTU ASEAN 9 + 1 Competitiveness Ranking Indices”, paper presented at the inaugural launch organised by the Institute of Policies Studies, Shangri-la Hotel, Singapore, 2 April
- Khee Giap, Tan (2004a) “Regional Cooperation and Integration in Asia on Monetary and Financial Reforms: The Long Overdue Agenda and the Pragmatic Strategy Forward”, paper presented at the “High Level Conference on Asia’s Economic Cooperation and Integration” organized by the Asian Development Bank, ADB Headquarters, Manila Philippines,1 – 2 July.
- Khee Giap, Tan & Kang, Chen (2004), “Enhancing Singapore’s Competitiveness: Some Fundamental Rethinking”, paper prepared for the Asian Economic Panel Meeting jointly convened by Hong Kong Institute of Economic and Business Studies, The University of Hong Kong, Earth Institute, Columbia University, Global Security Research Center, Keio University,and Korean Institute for International Economic Policy, Hong Kong, 12 –1 3 April.
- Hew, Dennis (2004), “SME Policies and SME Linkage Development in Singapore”. A chapter in “Entrepreneurship and SMEs in Southeast Asia” edited by Dennis Hew & Loi Wee Nee, published by Institute of Southeast Asian Studies, Singapore.
- The IFER Report (2002), “Restructuring the Singapore Economy”, chaired by Tommy Koh, Tan Khee Giap and Arun Mahzihinan, The Institute of Policy studies, Times Academic press.
- Tharman, Shanmugaratnam (2004), “SMEs: A New Role in Economic Strategies”. Forward in “Entrepreneurship and SMEs in Southeast Asia” edited by Dennis Hew & Loi Wee Nee, published by

A LIBERAL TRADE AND INVESTMENT ENVIRONMENT FOR INTERNATIONAL INDUSTRIAL CLUSTERING

SMIDEC

by

Kalsom Abdul Rahman
Chairman
SMIDEC

APEC Symposium on Industrial Clustering for SMEs

Taipei

8th March 2005

CONTENT

- **Introduction**
- **Economic strategies that encourage industrial clustering**
- **Clustering examples in Malaysia**
- **Impact of ICT in Clustering**
- **Conclusion**

SMIDEC

INTRODUCTION

INTRODUCTION

- Malaysian economic growth has been sustained through open global trading enviroment.

- Malaysia's position in 2004:
  - Total trade - USD 213.2 billion
  - Export - USD 116.7 billion
  - 19^{th} largest trading nation
  - 10^{th} single largest exporter to US

TRADE LIBERALISATION

ASEAN (Regionally) → China, India, Japan, CER

Bilaterally → New Zealand, Japan, India, Australia

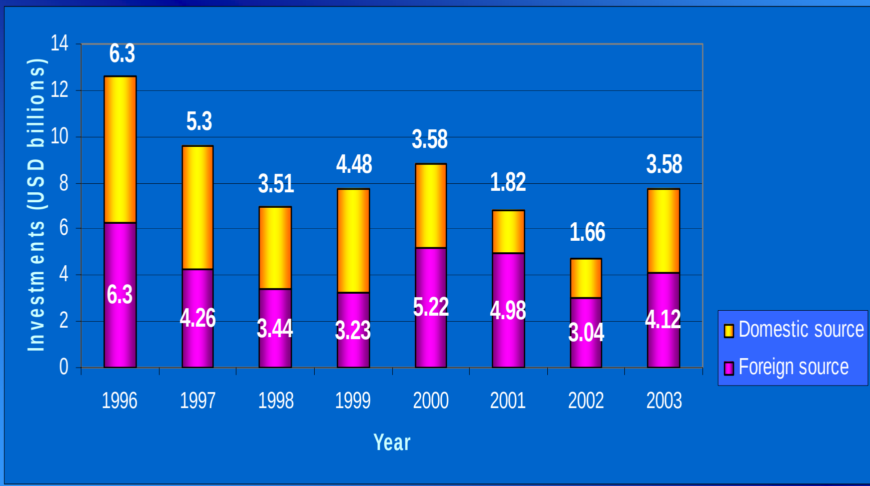
INVESTMENTS

In 2003:

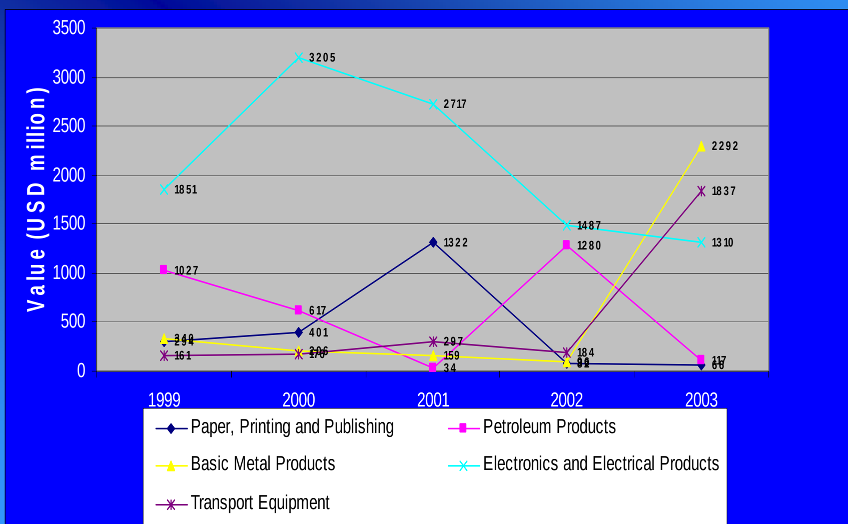
Total investments - USD 7.7 billion

- FDIs - USD 4.12 billion
- DDIs – USD 3.58 billion

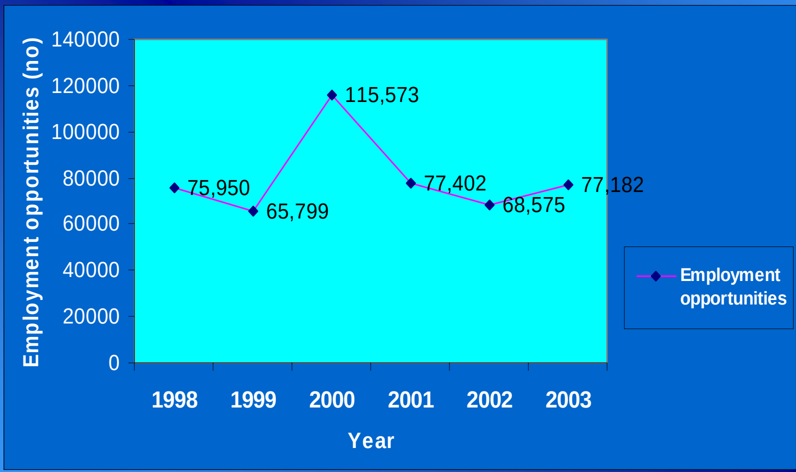
Total Investment in Malaysia (1996 – 2003)



Investments in Five Major Sub-sectors (1999 – 2003)



Employment Opportunities (1996 – 2003)



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ECONOMIC STRATEGIES THAT ENCOURAGE INDUSTRIAL CLUSTERING

ECONOMIC STRATEGY IN MALAYSIA

- **Medium and Long term economic plans and policy**

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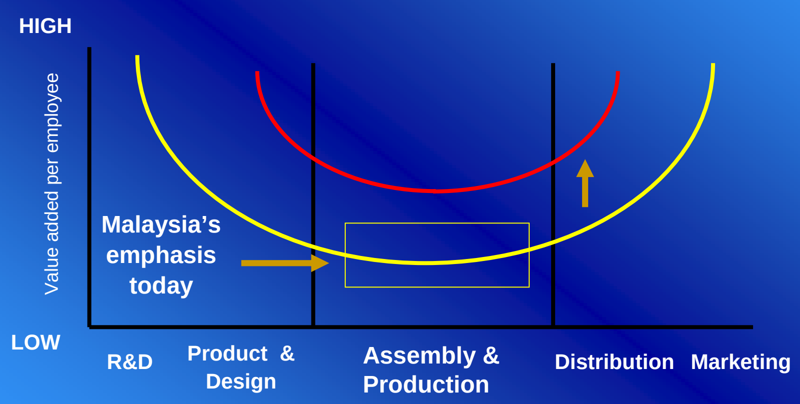
CLUSTER-BASED INDUSTRIAL DEVELOPMENT

- **Based on Manufacturing++ Strategy.**

  Two basic thrusts:

  - **moving along the value chain to increase value-added at either end of the chain; and**
  - **shifting the entire value chain to a higher level of activity, thereby increasing value-added at every point along the value chain**

FIGURE 4: MANUFACTURING++ STRATEGY



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CLUSTERING EXAMPLES IN MALAYSIA

MARKET DRIVEN CLUSTERING

Electrical and electrical sector located in Penang and Klang Valley

POLICY DRIVEN CLUSTERING

Automotive located in Tanjung Malim

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IMPACT OF ICT IN CLUSTERING

IMPACT OF ICT IN CLUSTERING

- enable businesses to remain viable and competitive
- increases the scope and range of potential new market
- enables manufacturers to integrate their business into global supply chain

GLOBAL SUPPLY CHAIN

⇕

VIRTUAL
INTERNATIONAL
INDUSTRIAL CLUSTER

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CONCLUSION

CONCLUSION

- Trade Liberalisation
  - wider option of input sourcing
  - better collaboration
  - resource sharing – technological capabilities and resource endowment
- Strengthening regional production network
  - AFTA – 11 priority sectors

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THANK YOU

When Do SMEs Benefit from E-Commerce in an Industrial Cluster? Evidence from a Biotech Cluster[1]

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1 Introduction

A considerable literature has focused on the critical role of business and industrial clusters found in cities and regions as drivers of any nations' economic health (Breschi & Malerba, 2001; Dunning, 2000; Markusen, 1996; Porter, 1990, 1998, 2000, 2003; Saxenian, 1994). In much of this work, the emphasis is on the way in which clusters of firms in common industries benefit from geographic co-location, enabling companies to achieve a higher level of competitiveness than they would otherwise if located outside of the cluster (Porter, 1998, 2000). Knowledge spillovers that enhance learning and innovation by firms in the cluster, the presence of supportive local institutions, the availability of specialized suppliers and service providers, access to a qualified pool of workers, and pressures from local competition are several of the many factors posited to explain the growth and dynamism of local and regional industrial clusters (Feldman, 1994; Maskell, 2001; Porter, 2000; Saxenian, 1994; Scott, 2000; Storper, 1995).

The role of information and communication technologies (ICTs) in the development and maintenance of local industrial clusters has not received a great deal of attention by this research community. This is surprising, given the attention policy makers and researchers pay to the role of communications infrastructures as an input to local and regional economic success (Moss, 1987; Parker, Hudson, Dillman, Strover, & Williams, 1995). More recently, governments are focusing on the need for a local broadband infrastructure in order to stimulate the growth of local industry, particularly in knowledge intensive sectors like biotechnology and high technology (NTIA, 2004; OECD, 2001). One of the key goals behind investments in local broadband access technologies, as well as other aspects of public telecommunications infrastructure, is to improve conditions for small and medium-sized enterprises (SMEs) (NTIA, 2004; OECD, 2004). SMEs are considered to be engines for economic growth, and in the United States, they account for the majority of the workforce and the gross domestic product (SBA, 1997). Public sector support is often justified by the argument that SMEs do not have the resources to build and maintain the ICT infrastructure needed to support inter-organizational transactions (OECD, 2004).

The goal of this paper is to explore how ICT networks may be used in industrial clusters, especially by SMEs. The two primary research questions addressed are as follows:

1) How do firms embedded in a cluster use public ICT infrastructures such as broadband access to the Internet?
2) Under what conditions do firms in a cluster, especially SMEs, benefit from Internet usage?

Addressing these two research questions contributes to emerging theory on the mechanisms through which business clusters convey competitive advantage. In addition, the answers can provide insights into a fundamental policy issue for local, regional, and national governments: how provision of a public ICT infrastructure aids clusters.

These questions are investigated through a case study of a European biotechnology cluster known as the Medicon Valley, located in Denmark and Southern Sweden. Interviews with ten organizations in the cluster, including several SMEs, yields a number of insights into the complex interactions between use of ICT networks and membership in an industrial cluster.

The remainder of the paper is organized as follows: In section two, previous literature relevant to the question of how ICTs are used in industrial clusters is reviewed. In section three, details about the case study are provided, including an overview of the research approach and general background on the Medicon Valley. In section four, findings from the interviews are described. A discussion of the results and their implications for theory and practice is provided in section five. The sixth and final section offers conclusions, as well as study limitations.

2 Literature Review

The clustering of economic activity is a well known phenomena, usually explained by the benefits that proximity affords firms and consumers in reducing many different types of transaction costs (Leamer & Storper, 2001). Leamer and Storper (2001) observe, for example, that clustered retailing reduces buyers' shopping costs, proximity reduces transportation costs in many types of material productions, and intellectual exchange is greater when participants are located near each other. Porter (1998, p. 10) defines business clusters as a "critical mass of companies in a particular field in a particular location…" which, in addition to producers of some good or service, includes "…suppliers of specialized inputs, components, machinery, and services, and firms in related industries." Clusters can also include "firms in downstream industries, producers of complementary products, specialized infrastructure providers, and other institutions that provide specialized training, and technical support" as well as industry groups such as trade associations (Porter, 1998, p. 10). Porter and other researchers have studied many aspects of industrial, or business clusters, including the preconditions for cluster formation, the forces driving cluster growth and development, the flow of knowledge and resources within and across clusters, and factors that influence cluster competitiveness and innovativeness (Breschi & Lissoni, 2001; Breschi & Malerba, 2001; Chiesa & Chiaroni, 2004; Porter, 2000; Powell, Koput, Bowie, & Smith-Doerr, 2002; Saxenian, 1994).

Despite the wealth of industrial cluster studies, relatively little research has specifically examined the role of information and communications infrastructure in influencing cluster success. There has been extensive research examining the role of the telecommunications infrastructure in economic development, particularly for less developed nations, regions, and rural communities (Gibbs & Tanner, 1997; Hudson, 1984, 1997; Jussawalla & Lamberton, 1982; Mansell & Wehn, 1998; Saunders, Warford, & Wellenius, 1994). There has also been a significant discussion about the importance of the telecommunications infrastructure for urban development (Moss, 1987). As noted above, these discussions have received renewed attention in recent years to help justify policies that facilitate the rapid deployment of broadband access technologies such as digital subscriber loop (DSL) (NTIA, 2004; OECD, 2001, 2004). Yet, for some reason there has been relatively little explicit attention to ICT infrastructure use within the context of industrial cluster research (Steinfield, 2004b).

There are good reasons to explore ICT usage in industrial clusters. First, knowledge about ICT usage can better inform policy-making, suggesting opportunities for more targeted interventions than simply blanketing a region with broadband access. Some types of cluster members – SMEs in particular – may need extra assistance, for example, in incorporating ICTs into practice (Gibbs & Tanner, 1997). Second, ICT usage patterns may reveal underlying cluster dynamics that can complement existing cluster studies and help researchers better understand how clusters succeed. Research has focused, for example, on patterns of knowledge transfer among cluster members, focusing on the kinds of formal and informal exchanges that occur within clusters and across regions in order to explain the innovative capacity of a cluster (Cooke, 2001, 2002b; Dunning, 2000; Powell et al., 2002; Powell, Koput, & Smith-Doerr, 1996; Rogers & Larsen, 1984). Interactions over electronic networks may complement and enhance local knowledge sharing, replace it with non-local exchanges, or contribute to the importation of new knowledge that is then shared within a cluster (Simmie, 2003). Third, research on ICT usage in industrial clusters may also shed light on the local and global impacts of the increasing use of electronic networks for a wide range of transaction and coordination activities (Hicks & Nivin, 2000). Electronic commerce researchers, for example, have begun to question the extent to which e-commerce helps or hinders local economies, and increases or decreases the centralization of economic activity (Steinfield & Klein, 1999; Steinfield & Whitten, 1999; Zaheer & Manrakhan, 2001).

2.1 ICT Usage in Industrial Clusters

At a very basic level, there are two somewhat independent functions that a local ICT infrastructure might fulfill in local business clusters. One set of functions relates to connectivity within the cluster for coordination and collaboration. This might include the increased ability that ICT networks provide for employees to connect to their firms from home or other external locations, enabling telecommuting and telework. Although research findings are mixed, telework use may improve a firm’s productivity as well as its ability to attract and retain certain types of workers who might need flexible arrangements (Kraut, 1989; Westfall, 2004). In addition to such intra-firm uses are applications of ICT networks to facilitate information sharing and collaborative work within and across firms in a cluster. Most research on ICT-enabled collaborative work focuses on the support of distributed teams engaged in brainstorming, coauthoring, design, problem solving, or decision making tasks (Grudin, 1994), but this literature is generally quite disconnected from the research on coordination among firms in an industrial cluster. The second broad set of functions that an ICT infrastructure can provide for an industrial cluster is linked to the use of networks for electronic commerce transactions. There is a rich literature on electronic commerce, often distinguishing between business-to-business trade and business-to-consumer trade, but rarely is its use in the context of geographically-defined industrial clusters examined (Steinfield, 2004a, 2004b). Electronic commerce researchers have emphasized the way that electronic markets can support business communities, but these communities are virtual in nature, and, in some respects can be thought of as something of a substitute for proximity-based clusters (Steinfield, 2004a, 2004b).

Most commonly economists and information systems researchers view the spread of ICT networks as one of the main factors contributing to globalization by virtue of the speed with which it allows communication, information, and transactions to flow across large distances, thereby reducing coordination and search costs that formerly inhibited such trade (Bakos, 1997, 1998; Cairncross, 1997; Choi, Stahl, & Whinston, 1997). This view suggests that the advent of high capacity, global ICT networks enables increases outsourcing and encourages firms to replace local trading partners with distant ones that might offer lower costs and higher quality. At the extreme, the replacement of in-cluster trading relationships with distant ones might ultimately diminish the benefits that come from being in a cluster. In this view, *greater use of electronic commerce may damage a cluster by weakening the trading relationships among members and reducing local cooperation*.

Others have argued for a more nuanced view of the connection between ICT usage and the activities of firms in local and regional business clusters, recognizing that such clusters exist in an increasingly interdependent and global network of economic relations among nations. In a wide ranging review of research on economic geography, Scott (Scott, 2000), citing Veltz (Veltz, 1997) summarizes this view by observing the trend towards, "mounting levels of functional integration of different national economies; …durably anchored in … a worldwide archipelago of stable regional economies or global city-regions" (p. 494). ICT networks function to permit firms to locate in cities or regions where conditions are favorable (e.g. presence of a labor market with appropriate skills and education, presence of firms offering complementary products and services, etc.), without harming their ability to reach global customers and suppliers. Moreover, innovative firms can use their connections to a global ICT infrastructure like the Internet to bring new knowledge into a region, which may then diffuse among local trading partners. Some research suggests that large firms, especially multinationals, play an important role in bringing in new knowledge into a cluster, which then spreads to smaller firms and improves cluster innovativeness (Simmie, 2003). Moreover, smaller firms in these clusters are more often innovative, because they are less rigid and less locked into established practices (Cooke, 2002a). In this view, *ICT usage enables export-oriented clusters to better access distant markets and import knowledge, without harming the internal dynamics that have helped to sustain the cluster* (Hicks & Nivin, 2000; Zaheer & Manrakhan, 2001).

Within the field of information systems, two well known papers have directly explored to potential use of an ICT infrastructure to improve coordination within an industrial cluster, arriving at somewhat opposing conclusions. Johnston and Lawrence's (1988) seminal work on value-adding partnerships focused extensively on the Prato, Italy textile industry. In this cluster, several large textile mills had disaggregated into small, specialized firms, each focusing on one part of the overall value chain in textile production (e.g. washing, coloring, cutting,, etc.). They showed how networks of firms worked in concert to meet the market demands for the good of the network, and pointed out how an inter-organizational information system was being used to facilitate coordination (Johnston & Lawrence, 1988). However, a decade later, Kumar and colleagues revisited the merchants of Prato, and found that the information system had been all but abandoned (Kumar, van Dissel, & Bielli, 1998). In their analysis, the system offered no real added value in terms of transaction cost reductions over the personal forms of coordination that had evolved over centuries of textile production in the region. Kumar et al (1998) suggest that trust and personal relationships – the social capital of the region – were effective substitutes for the inter-organizational system, rendering it unnecessary. Other research on clusters characterized by intense internal trading relationships has similarly observed the crucial role of social embeddedness, noting how personal connections create advantages for trading partners that may not arise in arms-length market transactions (Uzzi, 1996). This line of work suggests that *attempts to automate transactions and replace personal interactions within clusters may cause more harm than good*, a finding that parallels many other studies of the impact of business-to-business electronic commerce on buyer-seller relations (Caby, Jaeger, & Steinfield, 1998; Kraut, Steinfield, Chan, Butler, & Hoag, 1999; Schultze & Orlikowski, 2002; Steinfield, Kraut, & Plummer, 1995).

Much of the attention on business clusters today focuses on new industries, usually in emerging technology sectors such as information technology, new media and biotechnology

(Audretsch, 2001; Chiesa & Chiaroni, 2004; Cooke, 2001, 2002a, 2002b; Lemarie, Mangematin, & Torre, 2001; Powell et al., 2002; Powell et al., 1996; Saxenian, 1994; Saxenian & Hsu, 2001; Yukawa, 2004). In these types of knowledge-intensive clusters, rather than emphasizing transactions within the cluster, or even explicit coordination among cluster members, researchers have begun to focus on other ways that such clusters improve their competitiveness. A number of cluster researchers emphasize the importance of local trade or government-sponsored associations that work to promote the development of the cluster (Chiesa & Chiaroni, 2004; Cooke, 2002a; Turner, 2003; Yukawa, 2004). These associations engage in educational activities aimed at improving the cluster's human capital, branding and promotion activities such as conferences, exhibitions, Web sites, and business directories that help attract labor, venture capital, and business opportunities for the cluster, and online and offline social/community activities that create opportunities for knowledge sharing among cluster members, even when they do not explicitly trade with one another. These latter activities, strengthened by the geographic proximity of firms in a cluster, are also viewed as important mechanisms to improve the exchange of tacit knowledge – knowledge gained through habit, culture and experience that is not easily codified and shared (Asheim & Isaksen, 2002; Howells, 1996; Lam, 2000; Polyani, 1967; Powell et al., 2002; Simmie, 2003; Teece, 1986). Importantly, many of these activities explicitly involve *the use of ICT as a tool for cluster promotion and development*, even if not strictly for the purposes of supporting inter-firm electronic commerce transactions.

2.2 Summary

A number of key roles for the ICT infrastructure in business clusters are suggested by the above review. First, firms within the cluster benefit from the presence of high quality local

Internet access. It can enable more flexible work arrangements and lower costs for firms to support distributed workers that need to collaborate. Research on telecommunications and economic development further suggests that investment in an ICT infrastructure may particularly benefit SMEs and firms in rural areas, due to their lower resources and initial connectivity options. Second, although some concern has been expressed regarding the potentially destabilizing effects of the Internet on clusters, in that it permits firms to substitute distant trading partners for local ones, research from a social embeddedness perspective suggests this is an unlikely outcome. Rather, the studies reviewed above suggest that connection to a global ICT infrastructure like the Internet benefits clusters by improving access to distant markets without harming internal cluster dynamics. Moreover, the use of ICTs further promote cluster innovation by facilitating the transfer of technology from distant markets to firms in the cluster, which can then diffuse through informal channels even when firms in the cluster have little trade with each other. Finally, the review points out that in new knowledge-intensive clusters, an important use of ICTs is to help promote and maintain cluster brand identity, as well as to facilitate information sharing within the cluster.

3 A Case Study of the Medicon Valley

The roles for ICT infrastructures in business clusters were examined in a case study of a well known European biotechnology cluster, The Medicon Valley located in Denmark and Southern Sweden, in the summer of 2004. We selected this biotechnology cluster for several reasons. First, this is an increasingly important sector in many economies, and there have been repeated attempts worldwide to develop successful clusters in biotechnology (Cooke, 2002b). Given this worldwide interest, there has been significant research on biotechnology clusters (Audretsch, 2001; Audretsch & Stephan, 1996; Cooke, 2002a, 2002b; Frank, 2002; Wolff, 2003; Yukawa, 2004). Second, SMEs play a significant role in the field of biotechnology, and are important participants in biotechnology clusters (Audretsch, 2001). Third, the Medicon Valley has been a highly successful example of a biotechnology cluster, achieving a prominent global position in this highly sought-after sector (Frank, 2002; Wolff, 2003). Fourth, it is a knowledge intensive industry, placing more emphasis on information transfer than the transfer of physical goods (Cooke, 2002b; Powell et al., 2002; Powell et al., 1996). Hence, it offers great potential to reveal important uses of ICTS for information sharing and coordination within the cluster. Finally, biotechnology is a global industry, and the Medicon Valley has several significant multinationals that anchor the cluster (www.mediconvalley.com). As such, biotechnology clusters contain what Porter calls "traded industries" (Porter, 2003) offering an opportunities to explore global ICT usage, including e-commerce connections with distant markets.

3.1 Research Methods

Data for the study were gathered from archival sources, interviews with representatives from companies in the region, and interviews with representatives from the Medicon Valley Academy, a not-for-profit, member-financed association that works to promote the region. In all, representatives from ten organizations, including the Medicon Valley Academy, were interviewed. A mix of small and large firms were chosen to help reveal differing ICT and e-commerce usage patterns among SMEs. All of the interviews were conducted in June of 2004, and each lasted typically one hour. Interview questions were open-ended and unstructured, attempting to elicit the variety of ways that firms use ICTs to interact and exchange information and products with other firms in the region, as well as with suppliers and customers outside the region.

3.2 The Medicon Valley in Brief

The Medicon Valley occupies a region covering Copenhagen and surrounding towns in Denmark, and the southern part of Sweden region known as Scania, including such cities as Lund, Malmo and Gothenburg. It is home to five science parks, hundreds of biotechnology, life sciences and pharmaceutical companies, and more than a dozen universities. Table 1 provides a number of statistics about the region, based on information from the Medicon Valley Academy (www.mva.org).

Table 1: Statistics on the Medicon Valley

Population in the region	2.9 million
Number of universities	14
Number of hospitals	26
Number of life sciences researchers	5,000
Number of biotechnology companies	125
Number of pharma companies	70
Number of medical technology companies	130
Number of clinical research organizations	15
Total number of employees in biotechnology, pharma, and medical technology	41,000
Percent of all life sciences exports relative to all of Sweden and Denmark	60%

source: Medicon Valley Academy (www.mva.org)

The region has enjoyed remarkable success, and is now ranked as the number three biotechnology region in Europe (www.mva.org). It was officially named Medicon Valley in 1997, but has been a center for pharmaceutical and life sciences research for much longer, with four of the world's leading pharma companies located there: AstraZeneca, H. Lundbeck, Leo Pharma, and Novo Nordisk. The region is considered to be especially competent in three major biotechnology research areas: diabetes, inflammation, and neurosciences (Boston Consulting Group, 2002).

4 Findings

Tables 2 and 3 present basic descriptive information for the organizations interviewed, including the ICT applications for inter-organization coordination discussed in the interviews. Company identities are not revealed at the request of those interviewed.

The six firms listed in Table 2 are biotechnology and pharmaceutical producer firms, while the four firms in Table 3 provide various types of supportive products and services. In general, the pharmaceutical and biotechnology producers are all export oriented, with the lion's share of their output destined for markets outside Denmark. The large companies among the set of pharma and biotech producers all maintain extensive internal information technology infrastructures, and in some cases use extended information systems to enable structured transactions with large suppliers and distributors of their products in other countries. Several of the firms mentioned use of electronic commerce mainly in the form of inventory-replenishment for their global distributors, rather than for retail-oriented sales to consumers. This is not surprising, given that their products would not normally be sold directly to consumers, but through a complex set of health care intermediaries. Within the cluster, there is little in the way of direct transactions or coordination among these firms. They do work with researchers from universities or smaller start-ups, and the interaction is largely using email when it does occur over an ICT infrastructure. Some efforts at structured computer-supported collaboration were mentioned, but generally, these efforts were not viewed as successful.

Table 2: Descriptive Information on Biotech Producer Firms Interviewed

Type of Company	Number of employees	Main products	Market Focus (local vs. non-local customers)	ICT applications
Large pharma	18.800	wide range of pharmceutical products, engages in research and development of new drugs.	Has presence in 69 countries, sells to distributors in 179	Has a significant internal IT infrastructure, including global network linking operations. Has some limited e-commerce capabilities, but most connections with external partners are via email. Has many partnerships, involving research collaboration. Will allow some external connections to internal network and has tried using computer-based collaborative systems, but much still done using simple email.
Large pharma	3,300	develops and manufactures drugs, significant R&D.	Sells drugs in more than 90 countries, R&D located in Medicon Valley. Has four manufacturing facilities elsewhere in Europe	has a significant internal IT infrastructure linking company operations on a global basis. Has used e-commerce with partners to which it licenses drugs for sale, mainly for inventory replenishment. Engages in R&D collaboration with external partners, but relies mainly on email for this.
Large biotech	1400	develops biotech products used for various types of disease diagnosis, especially for cancer diagnotistics.	Has operations in more than 20 countries, and works with distributors in 50 countries.	Has significant internal IT infrastructure linking company operations. Uses IT to manage transactions with distributors. Supplies sophisticated IT tools for analysis for R&D collaborators, from universities and elsewhere. Also uses the Web to present its products to help find new distributors.
Large biotech research	no data	conducts science to develop chemical and biological compounds that have commercial potential. creates spinoffs to capitalize on R&D results	Mainly located in Denmark, but is a subsidiary of a large food product producer that sells to a global market. Biotech R&D is mainly in collaboration with local researchers, especially in universities	Has a significant internal IT infrastructure, and facilities to support research. Main external ICT applications are email interactions among research collaborators, but also enables some high speed connections to research tools, especially for collaborators at universities.
Small biotech supplier	4	produces a blood test product	manufactures in region, sells globally using distributors. 97% of sales outside Denmark	Uses DSL for always-on Internet access, relies on email to connect with clients, send pdf brochures. Uses Web site hosted externally to provide product information, but not transactions.
Small biotech supplier	1	produces fermentation equipment	manufactures in region, sells globally without distributors	Uses DSL for always-on Internet access, relies on email to connect with clients. Uses Web site hosted externally to provide product information, but not transactions.

Table 3: Descriptive Information on Biotech Industry Support Firms Interviewed

Type of Company	Number of employees	Main products	Market Focus (local vs. non-local customers)	ICT applications
Large ICT firm	no data	develops ICT solutions for pharma and biotech companies	Danish subsidiary of large global IT supplier. Sells many products to other industry sectors in Denmark, but also selling specialized IT solutions to firms in region	Has a significant internal IT infrastructure, including global network linking operations. Also has extensive Web site, but sees IT solutions for biotech as too complex for Web sales. Mainly used for company information, overview of product line to potential clients to support in-person sales efforts. Sees market for security applications for biotech R&D.
Large personnel services firm	no data	provides recruitment services, especially for helping recruit scientific staff	Local division of large global employment services company. Emphasis is on recruitment services for biotech firms in the region	Internet used extensively for filling jobs, accounts for 90% of jobs filled. Many portals with CVs. But high level and very specialized jobs filled through personal channels. Relies extensively on email, but only after initial in-person contact to help market services to companies in region, complementary to job fairs, attendance at events like Biotech Forum.
Business consulting group	no data	provides range of business consulting services, emphasis on strategy, economic issues	Has offices in several countries, small group located in Medicon Valley focusing on gov’t and private sector firms region	internal ICT usage, but limited to email, and traditional communication system connections to clients in region. Extensive use of Web, dissemination of reports online, use of client sites for highlight results of consulting reports. Customer acquisition largely through word of mouth referral, however.
Medicon Valley Academy	approx. a dozen staff, 40+ firms in region belong as members	member-financed. provides a range of support services to promote region, including networking, legal advice, events, education, business directory, on and offline publicity	Located in the region, with offices in Lund, Sweden and Copenhagen, Denmark to enable close ties to government affiliated venture capital and support agencies in both countries.	Uses the Web extensively to promote Medicon Valley, maintains an online database of firms in the Medicon Valley, and publishes online newsletters and reports to help publicize regional activities. Has email contacts with members and helps connect members with each other and with external constituents. Also offers job listings online.

Among the small biotech producer firms, it was especially noteworthy to see a heavy reliance on local broadband access. These firms were both export-oriented, with one having nearly all sales going to distant markets. Nearly all interaction with remote clients and distributors was email-based. Both of these SMEs used the Web to promote their products, even though their online sites do not support transactions. In order to illustrate how remote customers are identified, the fermentation equipment supplier described a recent sale to a customer in China. The customer had found his company after searching online for fermentation equipment suppliers, and decided to contact him because he was in the Medicon Valley biotech cluster. The customer then emailed to establish communication, resulting eventually in a visit and formal contract.

The companies listed in Table 3 all provided complementary products and services to firms in the cluster. All highlighted the use of Web-based promotion and email interactions, but a common theme was the importance of in-person communication in the region to obtain clients and provide services. The important role of the member financed, not-for-profit association, the Medicon Valley Academy (MVA), was widely recognized by those we interviewed. Some MVA activities involving the use of an ICT infrastructure, including the extensive development of a Website that promotes the region, disseminates regional and biotech news and reports, lists companies in an online directory, and provides online job listings. Additionally, the MVA organizes many offline activities, including seminars and educational services, conferences and other biotech events, and regular meetings for members. They also provide substantial support services for firms thinking about moving to the Medicon Valley, for biotech workers considering relocating to the area, and for entrepreneurs seeking legal and financial advice. In large part, these are activities that capitalize on the proximity of members in order to benefit the cluster.

5 Discussion

In this section, we return to our two basic research questions, as well as the expected roles for the ICT infrastructure in clusters generated by our review.

5.1 How do firms embedded in a cluster use public ICT infrastructures?

In the case of Medicon Valley, as expected, it was clear that all firms benefited from the presence of high quality, broadband Internet access. For the larger firms, fully capable of implementing their own private data communications infrastructure, the public infrastructure clearly supported their ability in the region to support research collaborations with scientists at other smaller firms and at universities. It further enabled better access to research facilities from home, which might, in fact, improve the attractiveness of the firms in the region to biotechnology professionals. We clearly saw that an important aspect of biotech cluster competition is competition for human resources – the clusters that can attract the scientists have an advantage.

Smaller firms heavily depended upon low cost, broadband Internet access. Each of the small firms we interviewed described the importance of network connections for their business. It enabled low cost and timely communication with distant partners, and facilitated company presentation and promotion online.

Few firms in the cluster were engaged in what we might consider to be sophisticated electronic commerce, where transactions were provided in an automated fashion online. Yet e-commerce of a sort was practiced, even by smaller firms. They received inquiries from non-local customers who saw their Website. They initiated transactions and sometimes took orders via email.

A concern from the review of literature is that better network access might stimulate greater interaction with firms outside the cluster, to the detriment of the cluster. Our interviews suggest that is not the case at all. To be sure, the cluster is oriented towards exporting products – only a small fraction of output of these firms stays in the region. And clearly, access to a high quality ICT infrastructure supports non-local transactions, even if largely handled in non-automated fashions. However, there was no evidence of a weakening of the cluster due to increased ICT use. Indeed, much ICT use was for the purpose of local interactions, particularly between the support service organizations and the producers, and between research institutions and the producers. Furthermore, interviewees often described the importance of in-person contact to initiate relationships and generate referrals. ICT use with distant suppliers and customers appeared to strengthen the cluster. Larger firms could maintain connections to foreign biotechnology expertise, and as well as to distributors and their own decentralized operations, all while keeping critical research and management staff in the region. Smaller firms also with ties to the region could successfully generate business without having to move closer to their customer bases. These findings are consistent with the findings from cluster researchers who argue that connections to global markets and sources of knowledge strengthen the cluster and ensure a healthy mix of firms and increased innovative capacity (Hicks & Nivin, 2000; Simmie, 2003; Zaheer & Manrakhan, 2001).

The internal benefits of an ICT infrastructure were further highlighted by the role of the MVA, illustrating the interaction between online activities and geographic proximity. Members of the cluster support the MVA in their efforts to promote the cluster. The MVA has helped to build the brand name of the region – The Medicon Valley- and promotes it extensively throughout the world. Their use of ICT serves both a local and distant audience. It encourages connections locally, through online job listings and announcements of events and seminars. But it does not substitute for in-person events and meetings, through which personal connections are made that can lead to research collaborations.

5.2 Under what conditions do SMEs benefit from Internet usage in a cluster?

Our second question focused specifically on SMEs and asked how they benefited from the use of a public ICT infrastructure when located in a cluster. The findings reported here are suggestive of a cluster legitimizing effect that has not been discussed widely in previous cluster research. It was rather surprising to hear that SMEs were able to rely on a crude from of electronic commerce – static presentation of their firm via the Web in order to generate business from customers in other countries. Prior research on e-commerce use by SMEs would not lead to this prediction, and instead would suggest that SMEs, except for those selling niche products otherwise unobtainable in other markets, would find it difficult to generate sales online (Steinfield & Klein, 1999; Steinfield, Mahler, & Bauer, 1999). Their lack of a brand name, technical and financial resources to produce a professional looking online presence, and limited resources for marketing and promotion of their Website all should mitigate against success in attracting remote customers. However, when embedded within a cluster that has become well known in a given industry – essentially the cluster brand is established (Yukawa, 2004) – such remote e-commerce appears feasible for SMEs. *Clients find and trust SMEs, and are willing to initiate transactions using the Internet because the SMEs are in an established cluster with a strong reputation for excellence in the given industry*.

6 Conclusions

This case study has highlighted the critical role of the ICT infrastructure for industrial clusters, and suggested new insights into how SMEs in particular may benefit. Our research suggests that ICT use does not threaten, but rather enhances cluster viability and vitality. It further suggests that ICT infrastructure alone would not have the same effect. Rather, it is the interaction between cluster dynamics and ICT infrastructure that produce the types of benefits highlighted above. The research reported here suggests that SMEs would not gain as much from the use of the ICT infrastructure if not located in a cluster with a strong reputation. Presence in a branded cluster helps remote clients find SMEs, and trust them to perform the kinds of activities needed.

These findings should be encouraging to policy makers who are working hard to ensure high quality broadband infrastructures for economic development. However, the findings also warn against isolating the question of ICT infrastructure from other business development policies, and especially from policies designed to encourage the development of clusters in targeted sectors like biotechnology and high technology. The two work in concert, and may not result in the same benefits otherwise.

Our study is clearly limited, in that it is merely one case of one type of cluster, and we were able to conduct only a relatively small number of interviews. As such, we recognize the speculative nature of the findings, and realize that we are merely presenting an opportunity for additional research to confirm the types of effects encountered in this study. A much better test would be to contrast the gains from the use of improved ICT infrastructures obtained by isolated firms with those in established clusters.

7 References

Asheim, B., & Isaksen, A. (2002). Regional innovation systems: The integration of local 'sticky' and global 'ubiquitous' knowledge. *The Journal of Technology Transfer*, *27*(1), 77-86.

Audretsch, D. (2001). The role of small firms in U.S. biotechnology clusters. *Small Business Economics, 17*(1,2), 3-15.

Audretsch, D., & Stephan, P. (1996). Company scientist locational links: The case of biotechnology. *American Economic Review, 86*, 641-652.

Bakos, J. Y. (1997). Reducing buyer search costs: Implications for electronic marketplaces. *Management Science, 43*(12), 1676-1692.

Bakos, J. Y. (1998). The emerging role of electronic marketplaces on the Internet. *Communications of the ACM, 41*(8), 35-42.

Boston Consulting Group. (2002). *Commercial attractiveness of biomedical R&D in Medicon Valley: The role of R&D in attracting regional investments*. Copenhagen: Boston Consulting Group.

Breschi, S., & Lissoni, F. (2001). Knowledge spillovers and local innovation systems: A critical survey. *industrial and Corporate Change, 10*(4), 975-1006.

Breschi, S., & Malerba, F. (2001). The geography of innovation and economic clustering: Some introductory notes. *Industrial and Corporate Change, 10*(4), 817-834.

Caby, L., Jaeger, C., & Steinfield, C. (1998). Explaining the use of inter-firm data networks for electronic transactions: The case of the pharmaceutical and advertising industries in France. In S. MacDonald & G. Madden (Eds.), *Telecommunications and Socio-Economic Development* (pp. 191-204). Amsterdam: Elsevier.

Cairncross, F. (1997). *The death of distance*. Boston, MA: Harvard Business School Press.

Chiesa, V., & Chiaroni, D. (2004). *Industrial clusters in biotechnology: Driving forces, development processes and management practices*. London: Imperial College Press.

Choi, S., Stahl, D. O., & Whinston, A. (1997). *The economics of electronic commerce: The essential economics of doing business in the electronic marketplace*. Indianapolis, IN: MacMillan.

Cooke, P. (2001). Regional innovation systems, clusters, and the knowledge economy. *industrial and Corporate Change, 10*(4), 945-974.

Cooke, P. (2002a). New media and new economy cluster dynamics. In L. Lievrouw & S. Livingstone (Eds.), *The Handbook of New Media* (pp. 287-303). London: Sage.

Cooke, P. (2002b). Regional innovation systems: General findings and some new evidence from biotechnology clusters. *Journal of Technology Transfer, 27*(1), 133-145.

Dunning, J. H. (2000). Regions, globalization, and the knowledge economy: The issues stated. In J. H. Dunning (Ed.), *Regions, Globalization, and the Knowledge-Based Economy* (pp. 7-41). Oxford, UK: Oxford University Press.

Feldman, M. P. (1994). *The geography of innovation*. Boston, MA: Kluwer Academic.

Frank, L. (2002). Biotechnology in the Medicon Valley. *Nature Biotechnology, 20*, 433-436.

Gibbs, D., & Tanner, K. (1997). Information and communication technologies and local economic development policies: The British case. *Regional Studies, 31*(8), 765-774.

Grudin, J. (1994). Computer-supported cooperative work: Its history and participants. *IEEE Computer, 27*(5), 19-26.

Hicks, D. A., & Nivin, S. R. (2000). Beyond globalization: Localized returns to IT infrastructure investments. *Regional Studies, 34*(2), 115-127.

Howells, J. (1996). Tacit knowledge, innovation and technology transfer. *Technology Analysis and Strategic Management, 8*(2), 91-106.

Hudson, H. E. (1984). *When telephones reach the village: The role of telecommunications in rural development*. Norwood, N.J.: Ablex Publishing Corp.

Hudson, H. E. (1997). *Global connection: International telecommunications infrastructure and policy*. New York: John Wiley.

Johnston, R., & Lawrence, P. (1988). Beyond vertical integration: The rise of the value-added partnership. *Harvard Business Review*, 94-101.

Jussawalla, M., & Lamberton, D. (1982). Communication economics and development: An economics of information perspective. In M. Jussawalla & D. Lamberton (Eds.), *Communication economics for development* (pp. 1-5). Sydney: Pergamon Press.

Kraut, R. (1989). Predicting the use of technology: The case of telework. In R. Kraut (Ed.), *Technology and the Transformation of White-Collar Work* (pp. 113-133). Hillsdale, NJ: Laurence Erlbaum.

Kraut, R., Steinfield, C., Chan, A., Butler, B., & Hoag, A. (1999). Coordination and virtualization: The role of electronic networks and personal relationships. *Organization Science, 10*(6).

Kumar, K., van Dissel, H., & Bielli, P. (1998). The merchant of Prato -- revisited: Toward a third rationality of information systems. *MIS Quarterly, 22*(2), 199-226.

Lam, A. (2000). Tacit knowledge, organizational learning and societal institutions: An integrated framework. *Organization Science, 21*(3), 487-513.

Leamer, E. E., & Storper, M. (2001). The economic geography of the Internet age. *Journal of International Business Studies, 32*(4), 641-665.

Lemarie, S., Mangematin, V., & Torre, A. (2001). Is the creation and development biotech SMEs localised? Conclusions drawn from the French Case. *Small Business Economics, 17*(1,2), 61-76.

Mansell, R., & Wehn, U. (1998). *Knowledge societies: Information technology for sustainable development*. New York: Oxford University Press.

Markusen, A. (1996). Sticky places in slippery space: A typology of industrial districts. *Economic Geography, 72*, 293-314.

Maskell, P. (2001). Towards a knowledge-based theory of the geographical cluster. *Industrial and Corporate Change, 10*(4), 921-944.

Moss, M. (1987). Telecommunications, world cities, and urban policy. *Urban Studies, 24*(6), 534-546.

NTIA. (2004). *A nation online: Entering the broadband age*. Washington, D.C.: National Telecommunications and Information Administration.

OECD. (2001). *The development of broadband access in OECD countries* (No. DSTI/ICCP/TISP(2001)2/FINAL). Paris: Organization for Economic Cooperation and Development.

OECD. (2004). *ICT, e-business and SMEs* (No. DSTI/IND/PME(2002)7/FINAL). Paris: Organization for Economic Cooperation and Development.

Parker, E. B., Hudson, H. E., Dillman, D. A., Strover, S., & Williams, F. (1995). *Electronic byways: State policies for rural development through telecommunications* (2nd edition ed.). Boulder, CO: The Aspen Institute.

Polyani, M. (1967). *The tacit dimension*. New York: Anchor Books.

Porter, M. E. (1990). *The competitive advantage of nations*. New York: Free Press.

Porter, M. E. (1998). The Adam Smith address: Location, clusters, and the "new" microeconomics of competition. *Business Economics, 33*(1), 7-13.

Porter, M. E. (2000). Location, competition, and economic development: Local clusters in a global economy. *Economic Development Quarterly, 14*(1), 15-34.

Porter, M. E. (2003). The economic performance of regions. *Regional Studies, 37*(6&7), 549-578.

Powell, W. W., Koput, K. W., Bowie, J. I., & Smith-Doerr, L. (2002). The spatial clustering of science and capital: Accounting for biotech firm-venture capital relationships. *Regional Studies, 36*(3), 291-305.

Powell, W. W., Koput, K. W., & Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly, 41*(1), 116-145.

Rogers, E., & Larsen, J. (1984). *Silicon Valley fever: Growth of high-technology culture*. New York: Basic Books.

Saunders, R., Warford, J., & Wellenius, B. (1994). *Telecommunications and economic development, 2nd edition*. Baltimore: Johns Hopkins University Press.

Saxenian, A. (1994). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Boston, MA: Harvard University Press.

Saxenian, A., & Hsu, J. Y. (2001). The Silicon Valley-Hsinchu connection: Technical communities and industrial upgrading. *Industrial and Corporate Change, 10*(4), 893-920.

SBA. (1997). *The economic impact of small businesses*. Washington, D.C.: Small Business Administration.

Schultze, U., & Orlikowski, W. (2002, December). *When complementarity is not enough: The implications for unbundling services in the Internet era.* Paper presented at the International Conference on Information Systems, Barcelona.

Scott, A. J. (2000). Economic geography: The great half-century. *Cambridge Journal of Economics, 24*(4), 483-504.

Simmie, J. (2003). Innovation and urban regions as national and international nodes for the transfer and sharing of knowledge. *Regional Studies, 37*(6&7), 607-620.

Steinfield, C. (2004a). Explaining the underutilization of business-to-business e-commerce in geographically defined business clusters: The role of social capital. In M. Huysman & V. Wulf (Eds.), *Social Capital and IT*. Cambridge: MA: The MIT Press.

Steinfield, C. (2004b). Situated electronic commerce: Toward a view as complement rather than substitute for offline commerce. *Urban Geography, 25*(4), 353-371.

Steinfield, C., & Klein, S. (1999). Local vs. global issues in electronic commerce. *Electronic Markets, 9*(1/2), 45-50.

Steinfield, C., Kraut, R., & Plummer, A. (1995). The effect of networks on buyer-seller relations. *Journal of Computer Mediated Communication, 1*(3).

Steinfield, C., Mahler, A., & Bauer, J. (1999). Electronic commerce and the local merchant: Opportunities for synergy between physical and web presence. *Electronic Markets, 9*(1/2), 51-57.

Steinfield, C., & Whitten, P. (1999). Community level socio-economic impacts of electronic commerce. *Journal of Computer Mediated Communication, 5*(2).

Storper, M. (1995). The resurgence of regional economies ten years later: the region as a nexus of untraded interdependencies. *European Urban Regional Studies, 2*, 191-201.

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy, 15*, 285-306.

Turner, C. (2003, September 19-21). *New media industries: A quantitative research study.* Paper presented at the Workshop on ICTs and Business Clusters at the International Conference on Communities and Technologies, Amsterdam, The Netherlands.

Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. *American Sociological Review, 61*(4), 674-698.

Veltz, P. (1997). The dynamics of production systems, territories, and cities. In F. Moulaert & A. J. Scott (Eds.), *Cities, enterprises and society on the eve of the 21st century*. London: Pinter.

Westfall, R. (2004). Does telecommuting really increase productivity. *Communications of the ACM, 47*(8), 93-96.

Wolff, M., F. (2003). Biomedical cluster blossoms in Scandinavia. *Research Technology Management, 46*(4), 2-4.

Yukawa, K. (2004). *Internet companies in Japan after the collapse of the Internet bubble: An analysis of Internet companies and their cluster*. Tokyo: Fujitsu Research Institute.

Zaheer, S., & Manrakhan, S. (2001). Concentration and dispersion in global industries: Remote electronic access and the location of economic activities. *Journal of International Business Studies, 32*(4), 667-686.

Building an i-Community: The new Asia imperative for social development

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Abstract

In today environment, information is the key to everything. This paper presents the process of how to build an Information community (i-Community) in Thailand. The objective of i-Community is to take all the information available in the community and turn them into useful ideas allowing the community to make smart decisions. The success of i-Community depend on how people work together, create learning environment, that have impact on community and how they live their life. The topics such as how to choose location, how to get community involve, and the concepts of community chief information officer (Community CIO) and community reporter are also introduced.

The information community (i-Community)

In Kuppam, more than several hundred kilometers from Bangalore, India, one of the first information community (i-Communities) initiatives is created. The i-Community in Kuppam creates public-private partnerships to accelerate economic development through the application of technology while simultaneously opening new markets and developing new products and services. Dunn (2003) suggested that an i-Community is a thriving, self-sustaining economy where greater access to technology permanently improves literacy, creates income, and provides access to new markets, government services, education, and health care.

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The i-Community in Thailand intends to set up the community networks through the use of information technology. The concept of i-Community is to take all the information available in the community and turn them into useful ideas that allow the community to make smart decisions. The i-community has low priced access to the high-bandwidth communication supporting the new learning environment. People in i-Community can also find community information at any instant. The National Research Council of Thailand initially funded this project for a year. Today, the i-Community is managed and given financial support from the community.

Choosing location

Meanwhile, more than seventy percents of the Information Technology (IT) projects approved by the Thai government in 2003 are related to the electronic government (e-government). Only a small number of IT projects are focusing on the grass-root people. An interesting project among those is One Village One Internet Connection which the government intends to hook up more than seven thousand villages with at least one internet connection.

Surely, people in the up country have heard about the internet but not many of them have had a chance to get their hands on it. The technological gap between parents and children also comes into existence because the children tend to have an opportunity to experience technology from school while the parents are lack of proper training and equipment. What should be done now?

In 2004, the first i-Community in Thailand was developed in Namphong district, selecting from other ten locations, Khonken province in the northeastern part of Thailand, about four hundred kilometers from Bangkok. Namphong was chosen because after reviewing all the ten locations it became clear that Namphong met all the basic requirements of becoming an i-Community which are adequate telecommunication infrastructure, good size of the community, close distance to major highway, active school, containing industrial sites, having tourist attractions, and strong leadership in all level.

Getting community involved

How did we get the community involved? For starters, we notified the Khonken governor office and explained them the objectives of i-Community initiative. Luckily, this was an easy part because Khonken is one of the provinces besides ChaingMai and Phuket that Thailand government tried to promote and establish to become the first group of Information Communication and Technology cities (ICT cities). The government goal for these ICT cities was to keep the local economy booming, increase the level of IT industrial investment, and improve better living of the people by developing the readiness of IT infrastructure, more trade, exhibition, conference, and tourist in the area.

The first group of target audience in diffusing the i-Community concept in Namphong was sheriff, School principles, business leaders, and monks. How to get the community involved was a challenge. We worked closely in setting up the i-Community with the local people. Thus, i-Community project could be viewed as an IT project for social development rather than an technology project itself. It took several months to explain and inform the local people about the notion of i-Community. The true measure of success in this project was how people working together, creating learning environment, and making better decisions that would have the impact on the community and their lives.

Moreover, there was a steering committee consisted of key members in the community who participated and engaged in every activity of setting up the i-community. The i-community project truly allowed policy makers to see how information technology could have an impact on the community, create social economic value, generate learning environment, and improve the living standard of the community.

The equipment

Information Technology infrastructure was certainly one of the most important factors in setting up the i-Community. In Numphong district, limited numbers of people in the community had access to basic infrastructure such as telephone lines. Some had been requesting a telephone line for more than five years. Clearly in the case of broadband service, no telecom company would want to invest their resources in the areas where the number of users was still small. In order to get the broadband service from the telecom company, we had to promote the interest of the local community in using the broadband services and initially we could come up with almost thirty households; allowing us to successfully getting attention from the telecom company.

Even though there was a small number of users and little money to be made from offering basic broadband service in Namphong, the telecom company was willing to provide the services to the i-Community as the good will for their businesses. The telecom company shifted its focus from making money out of the users in the community to joining hands with the i-Community project. We tried to increase the IT literacy in the area and hope to see that the community had better access to information allowing people in the community to open up to more channels of communication and improve their decision making.

The i-Community server was located in the Namphong school – the biggest K12 school in Namphong consisting of over two thousand students. We chose this school because, first, it was equipped with those who are competent enough to maintain the system. Second, students could help promoting i-Community concept to their parents. Next, the principal had strong leadership and well connected with other leaders in the community. Forth, this school already offered many IT training courses to the community. Figure 1 shows the i-community network.

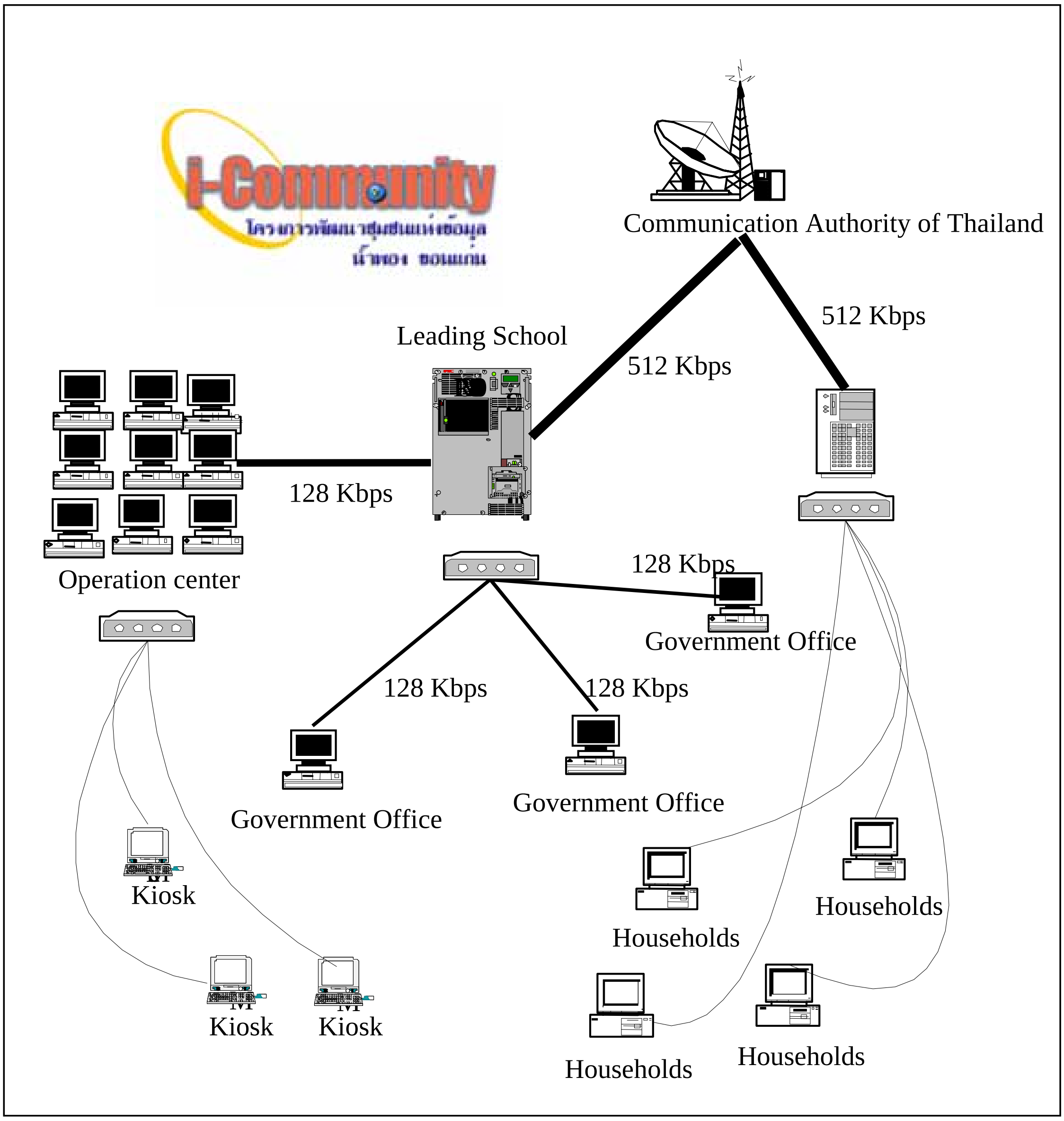

Figure 1 The i-community network

The community Chief Information Office (Community CIO)

The Community Chief Information Officer (CIO) was responsible for gathering and managing a wide array of information from the community. Then, organize the information into a simple format that could be easily used by the citizens with electronic access to the community server system. College students in the area were responsible for training the community members and those who already had some basic knowledge of computer to become the community CIO.

We currently have almost twenty community CIOs in the Namphong area. The community CIOs take the human-centered approach, meaning that they have to help the people in the area to increase their information technology literacy. The community CIOs are also now attempting to promote the use of equipment such as computer kiosks, which are in place through out the community. Figure 2 shows how people are using the i-Community kiosks to connect to the Internet in various locations.

Figure 2 How people are using the i-Community kiosks to connect to the Internet

The community reporter

Information is the key to drive the i-Community value. Davenport (1994) suggests that the human-centered approaches should focus on how people use information rather than machines. The information should be broad types and more emphasize on sharing. We selected several groups of students from Namphong school and trained them to become community reporters. These community reporters worked under the supervision of the teachers in the school. Without them, there would be very little information to put into the i-Community database.

The information

There are three types of information that was put into the i-Community database – information for people outside of Namphong, information needed from outside for people in the Namphong community, and information just for people in the community. Information is fundamental to decision making. People in Namphong widely use the Internet for news, searching for information, and showing their local products on the web. Martin and Cohill (1999) suggest that information generated by local people is worth more than its face value because it is backed by the integrity of fellow local citizens. A good example is the Namphong lottery database, which shows statistical records of how many people in the community spend on purchasing lottery. We are not trying to encourage people to buy lottery but using lottery information as a gimmick to hook people up online. The statistical data, such as how many times certain number has won, is in the i-Community database.

Before people can look at the lottery statistics, they must answer two questions. First, how much money did they spend on lottery last time? Second, how much did they win or loose. Assume six months have past, with only one keystroke, we can have information on how much money the community spend, win, and loose on the lottery. We do not need to persuade the community not to buy lottery, but the amount of the money they loose can help them make better decision – to reduce the amount of money spend on lottery or put it in a better use. Surprisingly, it helps teaching the community to think as a whole.

Other information in the database, for example, are how many acres in the community is growing cabbage, cutting date for each plantation, waiting time to deliver sugarcane at the sugar mill. Flexibility and better responsiveness due to information sharing help people in Namphong plan their harvest time well and make better decision. They know exactly the price and how much cabbage will be in the local market today. The farmer can make decision when to cut the cabbage and bring them to the market. Of course, the information may not help them much in term of making money, but it is better for them to make decision based on information.

Community commitment

The i-Community initiative only got funding in the first year from the government. It may be too soon to say how successful the i-Community will be after the equipment through out the community become out of date and need new replacement. When this happens, more money and community commitment is essential. Today, at the beginning of second year, there are many problems such as operation costs, the lack of monitoring people, and high costs of broadband network which account for more than sixty percent. To tackle such problems and to raise fund, a number of people in the i-Community are setting up the budget that will be used for maintaining the i-Community network.

The future of i-Community

Unfortunately, the future of i-Community depends heavily on the collaboration among stakeholders. As we have discovered, such collaboration leads to expansion of participation. For example, we can see the increase of IT and social development projects from government and private sectors not only in Namphong but also in Namphong proximity.

Today, i-Community operation center, which consists of about twenty personal computers, has become one of the popular social spots for the community. It provides access to information for everyone in the community. The primary interest of people in Namphong is to learn how to use computer, Internet, and simple software to solve practical problems of everyday life. Number of Internet users, amount of time spends, type of use, and information exchange also increase in the area. For those who do not come to the operation center, they can use the high speed Internet Kiosks that are located through out the community.

Thai government is also investing more money to reduce the digital divide not only for Thailand but also in collaboration with Laos and Vietnam. For instance, the Information Communication Technology Corridor project aims to reduce digital divide by way of building up the basic information technology infrastructure for grass-root people, linking member countries with high speed connectivity, and developing common skill standards to promote the flow of talents among member countries.

Lessons Learned

Namphong i-Community is the new Asia imperative for social development. It is a two-way communication network, allowing people to get and give information. It draws the new concept of social development by educating, creating teamwork, and generating information for better decision making. The more contents there are the more information will be exchanged. Many people in the i-Community now have a wide range of computer skills. They also develop basic research fundamental and become community researchers in order to contribute information to the i-Community database.

Strong commitment from all level is the key success factor for building i-Community. Now the involvement of the community goes to a whole new level. We are using technology to link people together and open up more opportunity. Certainly, the strategy is working. The digital divide may still exist in many areas, but surely the gap is decreasing in Namphong.

References

Davenport, T., "Saving IT's soul: Human-centered Information Management," *Harvard Business Review*, March-April 1994

Dunn, D., "Microcapitalism and the megacorporation," *Harvard Business Review*, August 2003

Martin, C. and Cohill, A., "Managing information in a community network," *Community Networks Lessons from Blacksburg*, Virginia, Artech House, Boston, 1999

Rassameethes, B., "Electronic commerce strategy and business model for agriculture Sectors in the Greater Mekong Subregion (GMS)," 2004 *AFITA/WCCA Joint Congress on IT in Agriculture,* Bangkok, Thailand, 2004

Rassameethes, B., "The supply chain modeling of pesticide free agricultural products in the Thai multinational supermarket, *EAN/TLAPS Industry-Academic 2nd Annual Conference on Supply Chain and Logistics Management*, Bangkok, Thailand, 2002

Figure 2 how people are using the i-Community kiosks to connect to the Internet

Promoting e-Commerce in SMEs with Programs that Leverage on Industrial Clusters -- the Case of Chinese Taipei

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March 8, 2005

Introduction

- Inter-firm e-business
  - planetary systems and Clusters
- Government funding for E-business activities in Taiwan
  - The programs
- Preliminary observation of the impact of the programs on small businesses

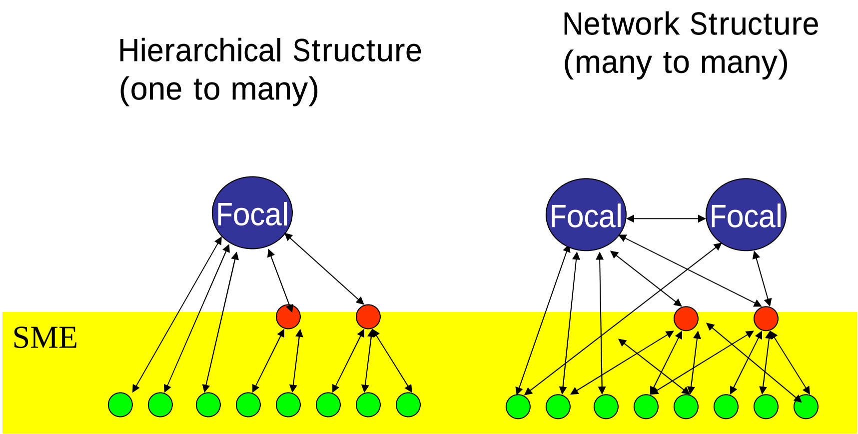
Inter-firm Relationship Locally

- Specialization of business domains by each company
- Focal company versus suppliers, service providers and channel partners
- Up to 100% of parts in a manufacturing company are purchased instead of in-house produced
- Complicated web of planetary systems

Cluster (1)

- Companies in the same sector, offering similar product types
  - E.g.: toys, hand tools
- Companies with the same business model
  - Retail store
- Key: Trade Associations

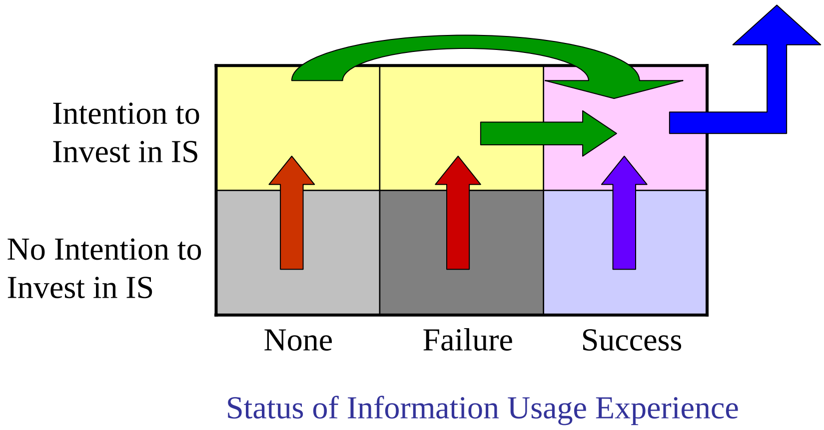
Cluster (2): Planetary Systems



Focal and satellites

- Focal companies are bigger
  - e.g. NT$ 2-400 bil. In revenue
- Satellites are typically small companies
  - ~70% without computer
- Complicated many-to-many relationship
- Focals are dominant, can be buyer or key component supplier

Differences in Requirements



Government (MOEA) programs

- Various government agencies provides funding sources, including
  - SMEA: Small and Medium Enterprise Administration
  - DOIT: Department of Industrial Technology
  - IDB: Industrial Development Bureau
  - DOC: Department of Commerce

DOIT/IDB/DOC programs

- DOIT
  - 1999 to present
    - Various Planetary systems supported
    - Started out with the Computer industry
- IDB
  - 2000: e-Business for Planetary systems
    - Textile, petro-chemical, auto-parts
    - Machineries, electro-mechanical, …
- DOC programs
  - 2000: e-Business for Planetary systems
    - Focus: demand chain, channels

DOIT/IDB/DOC programs

- Leveraging the dominant players in various industries
- Indirect effects on SMEs
- Supply chain and Demand chains
- At least 3000-5000 SMEs benefited
  - Phase 1: Stick and Carrots
  - Phase 2: Self motivated

SMEA programs

- 1999: e-Commerce program
- Two major types of programs relating to clusters
  - Diagnosis for IT applications
    - Funding for consulting services, through trade associations
    - Implementation of trade association based web-sites
  - Government support through Trade Associations

The Web funding program

- Starting 2002, 10 industrial clusters selected to receive support to start out their WWW-sites
  - Each trade association have implement system to include company data and product catalogs for at least 100 members
  - Industry specific information
  - Travel, toys, plumbers, orchid farming, handbags, clothing, etc.
  - Many success stories, including B-to-B, B-to-C, etc.
- http://info.moeasmea.gov.tw/list.htm

Range of government support

- Government support limiting to up to 50% of the total project budget
- Evaluation and selection committees are setup to review the cases, and to recommend successful candidates to appropriate authorities

Observations for the DOIT/IDB/DOC programs (1)

- Focal companies are in charge of getting the SMEs on board
- ¼ of the SMEs already have some form of computer applications
- Most of the SMEs (including the ones with computers) resisted the project initially
- Incentive schemes have to be deviced

Observations for the DOIT/IDB/DOC programs (2)

- About 1/3 of all interviewed welcome the idea, and found it useful
  - These are used as demo cases for latter stages
- The rest are still busy doing their normal business, some of the SMEs are in the process of moving overseas due to recent recession

Observations for the DOIT/IDB/DOC programs (3)

- Supply chain partners actually perceive the projects to be useful, and become committed
  - Actual improvement in turn around time and inventory level; secure the Focal
- Functions relating to payments are easiest point to cut in

Observations for the SMEA programs (1)

- Some Trade Associations are highly motivated, and end up with success
  - Functions important to the specific industrial domain have to be identified
  - Many companies stated out by gathering information to “ fill in the blanks, " and ended up investing more

Observations for the SMEA programs (2)

- Some Trade Associations are passive, and the related projects will be crippled
- In total, an effective ways to raise the awareness of IT implementation

Conclusion

- Too many SMEs
  - Difficult to support everyone
- The Industrial Cluster approach, both trade associations or planetary systems are effective channels
  - Real benefits to the focals and the trade associations
  - SMEs are supported indirectly, but more effectively
  - Local IT solution providers benefited from the programs

Linking Up SMEs for Survival: via Electronic Supply Chain and Cluster Management

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March 8, 2005

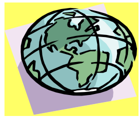
ROSETTANET
eBusiness Standards for the Global Supply Chain

Agenda

- Trends in Global Competition
- Survival Strategies: The 3 P's
- eLinking the Business
- RosettaNet
- Call to Action

ROSETTANET
eBusiness Standards for the Global Supply Chain

Trends in Global Competition



- Business outlook is uncertain…
- Globalization is happening…
  - "In this age of globalization, you have to accept that only profitable and competitive companies survive"
    Quote from former South Korean President Kim Dae Jung
- Successful businesses characteristics
  - Global competitiveness
    - Technology innovation
    - World class quality
    - Total cost
    - Agile, able to respond with speed
  - e-Business capable
    - Connected to global supply chain
  - Able to do business "virtually" across international borders

Agenda

- Trends in Global Competition
- Survival Strategies: The 3 P's
- eLinking the Business
- RosettaNet
- Call to Action

Survival Strategies: The 3Ps

External Environment:
•Business trends
•Technology trends
•Consumer trends

Proactive Positioning

CUSTOMER

Orders

Enterprise
Cost of doing business:
. People
. Processes & Systems
. Equipment
. Materials
. Capital

Productive

PRODUCT/SERVICE

Keep Orders Coming in

Bottomline :
Revenue from customers
(minus)
Cost of doing business

Profit

Product

ROSETTANET

Survival Strategies...the 3 P's

The Bottom Line in Business is to be Profitable: How?

- Product / Service which is in demand
  - Constantly look ahead and anticipate future needs
  - What sells today may not sell tomorrow
- Productive (Efficient use of resources)
  - Internal processes which enable fast reaction
    - Integrated systems & processes
    - Simplify to be agile – CUT Non-value-add
      - Red tape to speed up decision-making
      - Procedures/steps
      - Committees, hierarchy,unproductive headcount
    - Eliminate unnecessary paperwork
- Proactive Positioning for Survival
  - "Sense the wind direction" and pre-position to "sail with the wind"
  - Put strategies in place to keep orders flowing in
  - Position the organization to be easy to do business with:
    - We are in a "virtual world" now,
    - Be ready to capture business from anywhere
    - Be there for the customer/ trading partner "all the time"

Biz Opportunity needed to help SMEs kickoff

Nurturing Acts as catalyst

ROSETTANET

Supplier Development Model

"SMART" Approach

Harvesting

Nurturing

Seeding

Total Solution Supplier, Global Supplier

Refine through training & coaching

Allocate and increase opportunities appropriately

Match to business needs and provide initial training

Sourcing for suppliers who are willing and capable

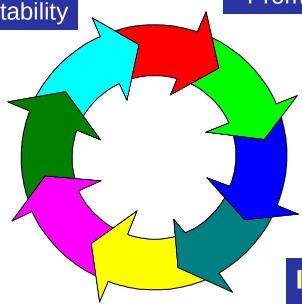
Government & Supporting bodies

Role of Government and Supporting Institutions

Business environment
- Re-orientation for globalization
- Political and economic stability

Robust educational system
- Multi skilled and agile workforce
- Promote learning organization

Financial Aids
- Incentives
- Tax exemptions



Good Infrastructure
- e-commerce capability
- gazette location

Industrial Promotion
- Opportunities for linkages & networking (trade missions)
- Foreign collaboration with local industries

Effective Policies
-Encourage foreign investment
-Encourage local supplier development

Survival Strategies...the 3 P's

The Bottom Line in Business is to be Profitable: How?

- Product / Service which is in demand
  - Constantly look ahead and anticipate future needs
  - What sells today may not sell tomorrow
- Productive (Efficient use of resources)
  - Internal processes which enable fast reaction
    - Integrated systems & processes
    - Simplify to be agile – CUT Non-value-add
      - Red tape to speed up decision-making
      - Procedures/steps
      - Committees, hierarchy,unproductive headcount
    - Eliminate unnecessary paperwork

Keep orders Coming…

- Proactive Positioning for Survival
  - "Sense the wind direction" and pre-position to "sail with the wind"
  - Put strategies in place to keep orders flowing in
  - Position the organization to be easy to do business with:
    - We are in a "virtual world" now,
    - Be ready to capture business from anywhere
    - Be there for the customer/ trading partner "all the time"

"Supply Chain Cluster"

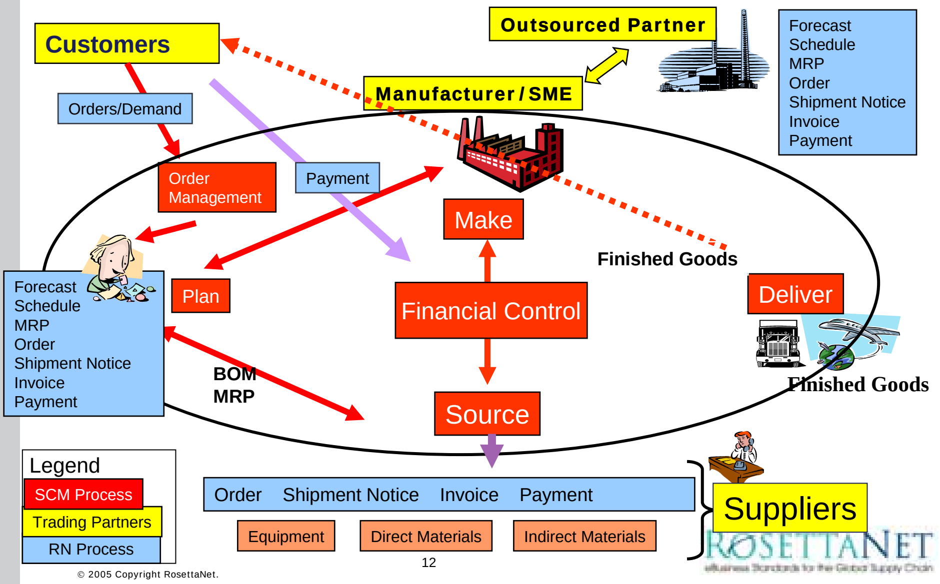
Boundaries Being Redefined

- Globalization is a huge "unstoppable" wave sweeping through the world
- The internet is rapidly becoming the "Business highway" for inter-enterprise trade
- Through the internet any part of the globe can reached within seconds
- Hence:
  - Supply Chain Cluster is
    - No longer geographically dictated
    - Expanded beyond international borders
    - The entire globe becomes "One massive cluster"

Agenda

- Trends in Global Competition
- Survival Strategies: The 3 P's
- eLinking the Business
- RosettaNet
- Call to Action

eLinking Your Supply Chain

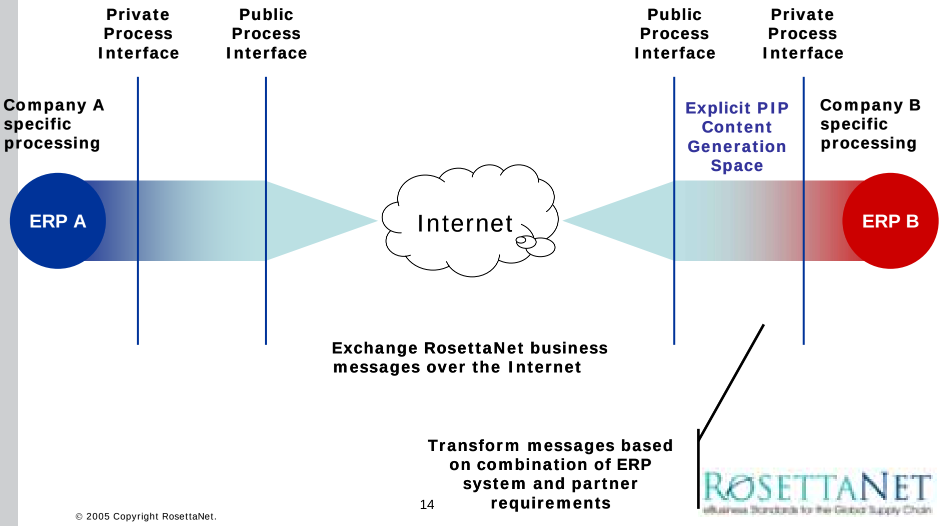


To eLink your Business,
And to enable System to System interface, it is necessary to have a common e-Business “language” .

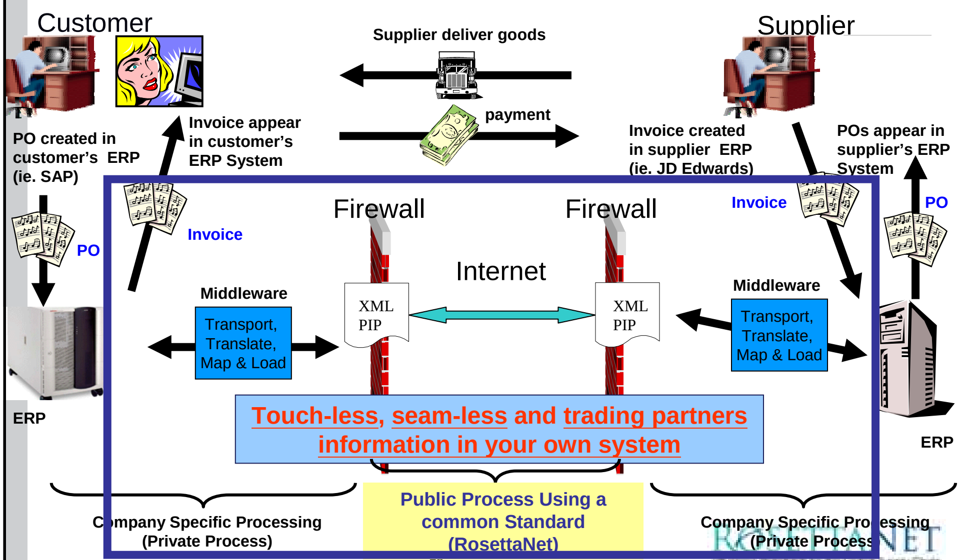
This is where RosettaNet comes in…

RosettaNet Standard

Partner to Partner eBusiness Interface



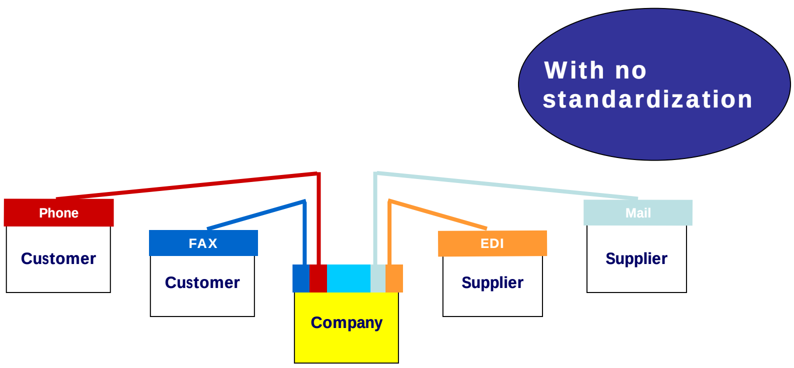
Partner to Partner Electronic Business Interface



ROSETTANET

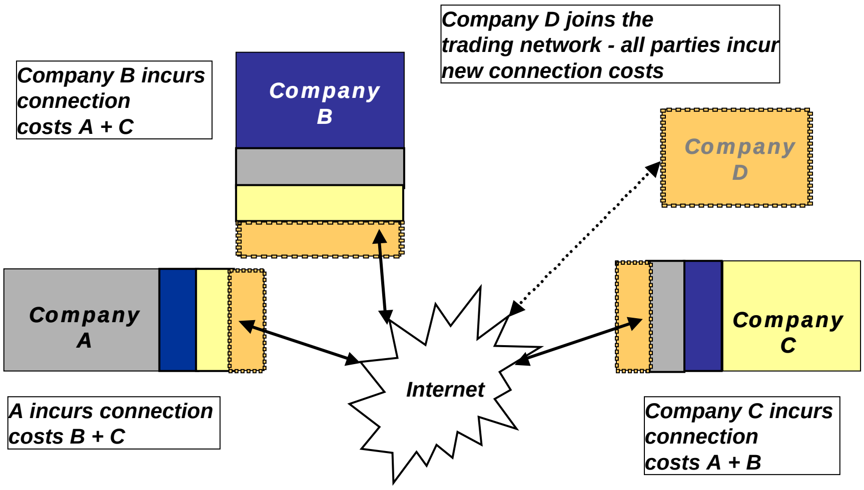
RosettaNet: Why is it cheaper ?

Different "Connection" and Custom Processes for Each Customer…



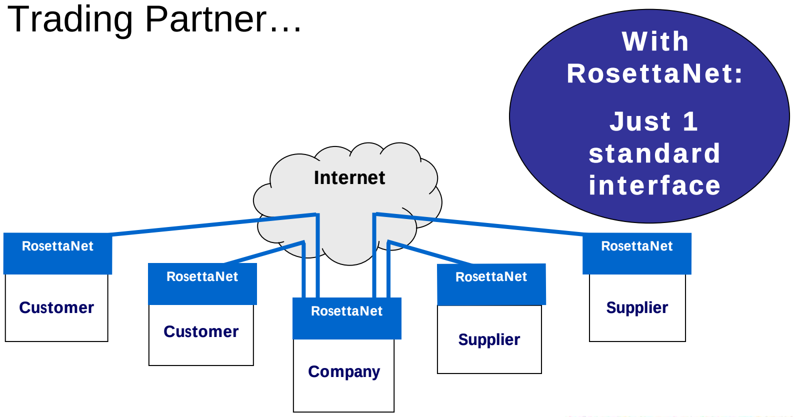
ROSETTANET

Business to Business Environment
Unique Connections



RosettaNet: Why is it cheaper ?

Single “Connection” and Process for Each Trading Partner…



Agenda

- Trends in Global Competition
- Survival Strategies: The 3 P's
- eLinking the Business
- RosettaNet
- Call to Action

RosettaNet

Vision & Mission

Vision: The leader in global e-business standards

Mission: RosettaNet drives collaborative development and rapid deployment of Internet-based business standards, creating a common language and open processes that provide measurable benefits and are vital to the evolution of the global trading network.

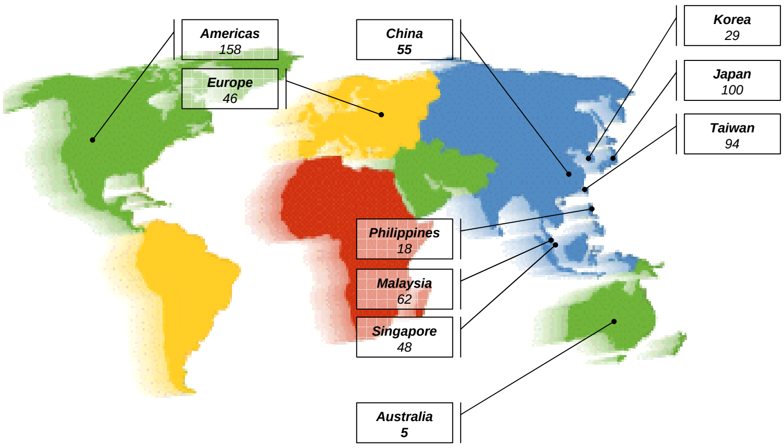
What is RosettaNet

RosettaNet is an independent, non-profit consortium dedicated to the collaborative development and rapid deployment of open, Internet-based business standards that align processes within the global high-technology trading network.

More than 450 companies representing over $1 trillion in annual information technology, electronic components and semiconductor manufacturing revenues currently participate in RosettaNet's standards development, strategy and implementation activities.

RosettaNet Partners

Worldwide Focus



Intel in RosettaNet

Growth Pattern

	2003	2004
RosettaNet Transactions	over $9B	over $12B
Customer Orders	20%	25%
Purchase Order Value	15%	40%
Trading Partners	150	186
Countries Connected	17	23
Business Processes Implemented	22	24

Intel in RosettaNet

Intel Readies EDI Retirement

Intel Readies EDI Retirement

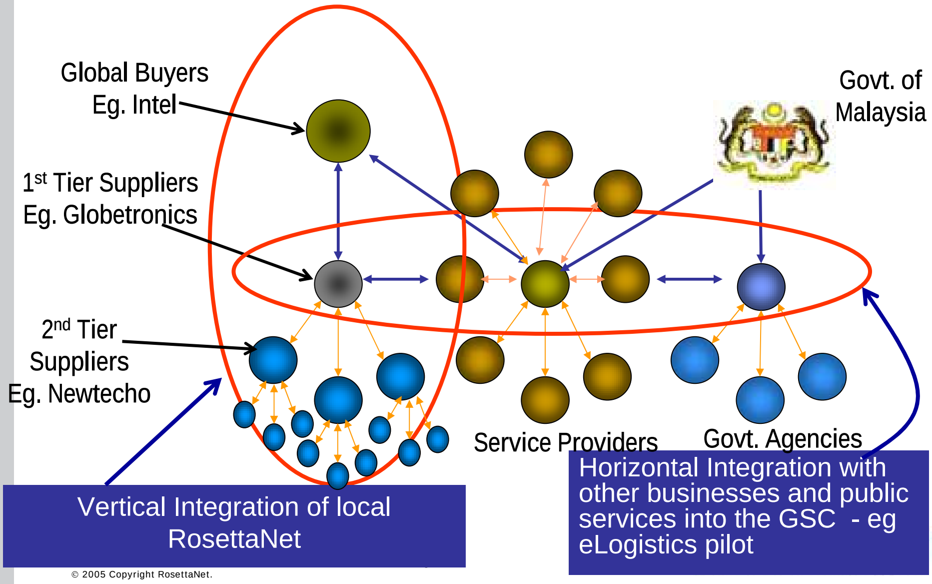
Santa Clara, Calif.--Intel said it will replace EDI with RosettaNet standards by 2006**, making it the first company to publicly commit to retiring electronic data interchange.**

The chip maker also said it has reached a RosettaNet milestone: By year-end, Intel will be swapping data in RosettaNet's XML formats over the Internet with 50 trading partners. Intel could save as much as 2 percent of revenue, or roughly $564 million**, annually by tuning its supply chain with Internet technology, estimated Vernon Keenan, founder of analyst firm Keenan Vision. That includes the move away from EDI. --Mitch Wagner**

More: www.internetweek.com/story/INW20011217S0001

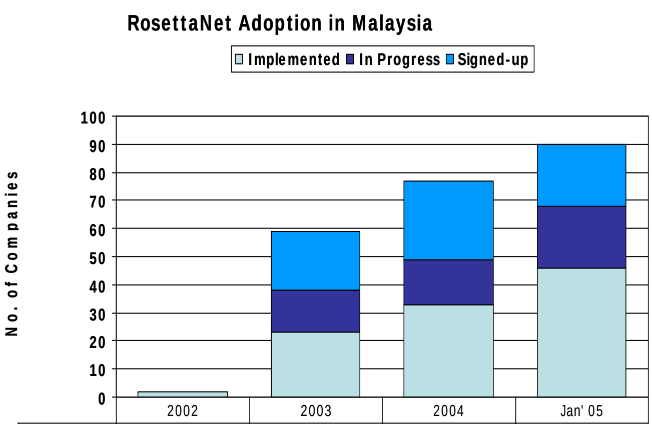
INTERNETWEEK.com, December 2001

Integrated Network to e-Enable Manufacturing



RosettaNet Adoption in Malaysia

Updated 31st Jan 2005



	2002	2003	2004	Jan' 05
Signed-up		21	28	22
In Progress		15	16	22
Implemented	2	23	33	46

- Implemented
  - Companies in Malaysia who had **gone live** with at least one PIP implementation
- In Progress
  - Companies in Malaysia who have **started the process** by buying software, hardware etc.
  - Companies in Malaysia with **approved RosettaNet Grant application**
- Signed Up
  - Companies in Malaysia who have **applied** the RosettaNet Grant
  - Companies who have **signed** agreement with Solution Providers

RosettaNet Connections in Malaysia

MNCs/Local Corporations, Updated Jan 2005

	Local		Overseas		Total	
	PIP Connection	**TP**	**PIP Connection**	**TP**	**PIP Connection**	**TP**
Dell	35	11	62	20	97	31
Intel	39	16	70	16	109	32
Polytool	8	2	No Connection		8	2
ISO	24	6	No Connection		24	6
Sony	6	2	TBD	TBD	6	2
BenQ	63	9	No Connection		63	9
Actual Connection	**350**	**46**	**264**	**36**	**614**	**82**

PIP Connection	Number of RosettaNet PIP (Partner Interface Process) implemented between each trading partner
Actual Connection	Total Number of Connections between Trading Partners (Calculated both-ways)

RosettaNet

Benefits at a glance

- Improved business efficiency
  - Real time information exchange
  - Improved traceability
  - Faster order to cash
  - Elimination of redundant data
  - Elimination of manual data entry
  - Less rework and fewer returns
  - Better inventory utilization/reduction
  - Collaborative design

Agenda

- Trends in Global Competition
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- Call to Action

ROSETTANET

Call to Action

- Globalization is inevitable
  - Harness this as an opportunity !!
- Embrace e-business to have a fighting chance
- Only profitable and competitive companies survive
- Get linked to the Global Supply Chain network
  - Be connected to global trading partners by "speaking" an interoperable open e-Business language

SMEs who do not want to be left behind should link to the global supply chain NOW !!

ROSETTANET

Thank You

RosettaNet
eBusiness Standards for the Global Supply Chain

RosettaNet

Business value of RosettaNet standards

- Our members have experienced
  - Cost savings
  - Process improvement and productivity gains
  - Competitive advantages
  - Increased customer satisfaction
- Membership value includes access to industry experts, research, established process methods, implementation guidelines, support, and services

RosettaNet
eBusiness Standards for the Global Supply Chain

RosettaNet

Industry Representation

- Semiconductor Manufacturers
- Electronic Component Manufacturers
- Computer and Consumer Electronic Manufacturers
- Telecommunication Services Providers
- Solution Providers
- Logistics Providers

RosettaNet Supply Chain Council Members

Agere Systems
Agilent Technologies
Air Products & Chemicals
Amkor Technology
Applied Materials
Arrow Electronics
ASE
Avnet
Cisco Systems
DHL
Elcoteq
Exel
Federal Express
Foxconn

HP
IBM
Intel
Infineon Technologies
Jabil Circuit
Menlo Logistics
Molex
Motorola
National Semiconductor
NEC
Nokia
Philips Semiconductors
Renesas Technology

Samsung Electronics
Shinko Electric Industries
Silicon Precision Industries
Sony
STMicroelectronics
Sun Microsystems
Texas Instruments
Tokyo Electron Limited
Toppan Printing
TSMC
Tyco Electronics
UPS

RosettaNet Solution Provider Council Members

- e2open
- Fujitsu Limited
- GXS
- IBM
- Microsoft
- NEC Corporation
- Oracle
- SAP
- Sterling Commerce
- TIBCO Software
- Viacore
- webMethods

ROSETTANET
eBusiness Standards for the Global Supply Chain

Gov't. Agencies, Trade Associations and Standards Organizations

- AFDEC (UK)
- AIIM
- ASC X12 & DISA
- CommerceNet
- CommerceNet Japan
- CompTIA
- CTC
- Customer Support Consortium
- ECA
- ECP.NL (Netherlands)
- EDIFICE (Switzerland)
- EDIMAN (Singapore)
- EIA
- EIDX
- ERA
- FMM (Malaysia)
- FREPENCA (Malaysia)
- IDA (Singapore)
- III (Taiwan)
- IPC
- Israel Association of Electronics & Information Industries (Israel)
- Institute of Software, Chinese Academy of Science (China)
- ITAA
- LMI
- MITI (Malaysia)
- MIMOS Berhad (Malaysia)
- MOST (Ministry of Science & Technology (China)
- NEDA
- NEMI
- NIST
- OAG
- OASIS
- OBI
- PDC (Malaysia)
- PPAI
- Si2
- SIIA

ROSETTANET
eBusiness Standards for the Global Supply Chain

University Alliances & Projects

Americas

- Arizona State University
- California Polytech
- Cornell University
- Harvard University
- Stanford University
- San Jose State University
- UC-Berkeley
- University of Illinois
- University of San Diego

Asia

- Fudan University
- Indian Institute
- Tongji University
- Jiaotung University
- National University

Europe

- Helsinki Technical University
- Insead

Project	University
Costing Model/Benefit Scorecard/Costing Scorecard	Arizona State University
Co-Adoption Model	University of Illinois
ROI Calculator Model	Stanford University

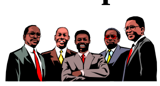
RosettaNet Governing Process

RosettaNet Executive Council

- **Provide overall guidance**
- **Address prioritization and integration across councils**

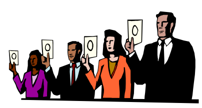
RosettaNet Managing Councils

- **Address supply chain specific issues**
- **Prioritization**
- **Resources**
- **Implementation and adoption**



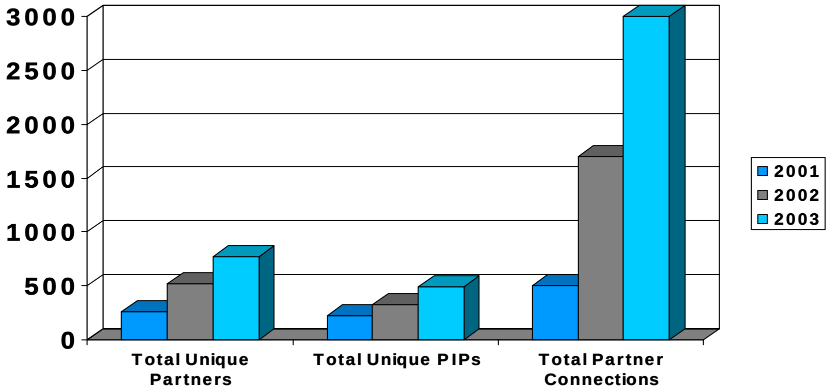
RosettaNet Partners

- **Vote on standards**
- **Participate in workshops**
- **Implement**



Production Implementations of RosettaNet Standards

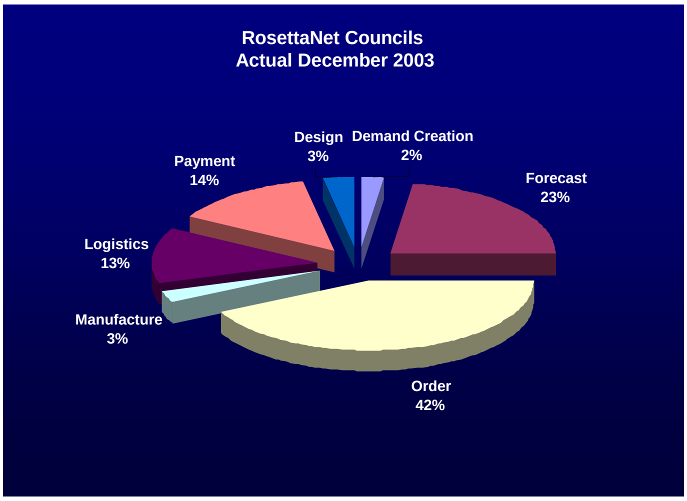
Unique Partners, PIPs® and Connections based on Reporting Council Members Inputs



Source: Council Scorecards Dec-03

ROSETTANET

Council Implementations By RosettaNet Business Process



ROSETTANET

RosettaNet Standards
Return on Investment: Key factors

- Direct Financial Impact
  - Cost savings and benefits
- Operational Performance Impact
  - Process improvement and productivity
- Indirect Impact
  - Competitive advantage and customer satisfaction

ROI Case Study 1

Arrow Electronics and Customer Implement PO Management

- Return on working capital was improved with better inventory management
- Manual order processing reduced by more than 90%
- Order entry improved, no more additional reentry tasks
- Order response time reduced from 8 to 10 hours to 2 hours for exception that require manual intervention and to less than 20 minutes for non-exceptions
- 24 X 7 real time ordering capability achieved
- Improved customer service

ROI Case Study 2

Avnet and Supplier Implement Order Management & Shipment

- Non-reoccurring startup costs of the initial implementation (infrastructure, middleware)
- Interest income benefits from invoicing more quickly. One source of entry and no more manual quality checks
- Partners can view information online, real time
- Purchase order processing reduced by 1 day
- Time between order shipment and customer invoicing reduced by 3 days
- Stronger team environment internally and between partners
- Customers received goods more quickly and customer satisfaction increased

ROI Case Study 3

Intel and Supplier Implement Order Management & Shipment

- Total elimination of substantial yearly autofax costs
- Elimination of manual downloads and data validation process
- 100% error free process environment
- By extending supply chain visibility into the entire business environment, business decisions are made with good, hard data. This allows a business to anticipate changes in the business climate and respond to those changes with greater agility

ROI Bibliography

Documents on the RosettaNet Web site

- Case Study #1: Arrow and UTEC replace EDI-based purchase order process with RosettaNet Standards
- Case Study #2: Avnet's E-Commerce with Web-Based Standards
- Case Study #3: Intel/Shinko

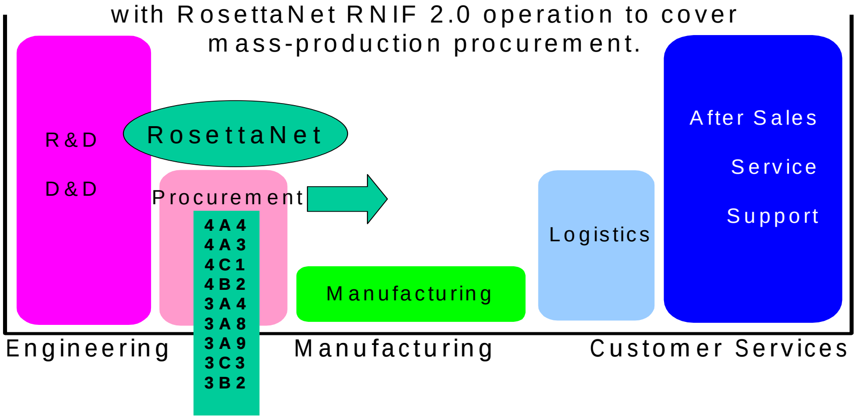
  – The referenced ROI documents are posted on www.rosettanet.org/roistudies

Sony's RosettaNet Strategy

Sony EMCS

2002 Full Scale Deployment!

Sony made decision to stop EDI-VAN, and replace with RosettaNet RNIF 2.0 operation to cover mass-production procurement.



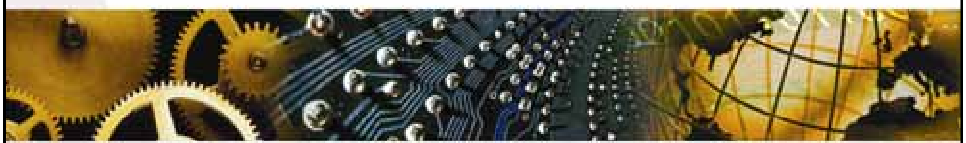
Nokia's RosettaNet Strategy

RosettaNet Vision in Nokia

- **Future Plans for Process Automation**
  - full range of planning, logistics & money flow processes
  - product data maintenance and synchronization
  - design collaboration
  - *AUTOMATION AND INTEGRATION*
- **360 degrees integration**
  - all external process interfaces RosettaNet compatible
  - helps and speeds-up out/in-sourcing of business
  - network orchestration

NO EXCUSE !!

17 © NMP Supplier Day 02.09.02_ Jean-Francois Baril CONFIDENTIAL NOKIA



ROSETTANET

eBusiness Standards for the Global Supply Chain

APEC Symposium

HOW SMEs BENEFIT FROM INDUSTRIAL CLUSTERS IN APEC REGION

Mr. Iván Ornelas
Chinese Taipei.
March, 2005

INTRODUCTION

The modern industrial economy has the following needs:

- New strategic structures derived from companies to **relate successfully with the new plans for competency and technological change.**

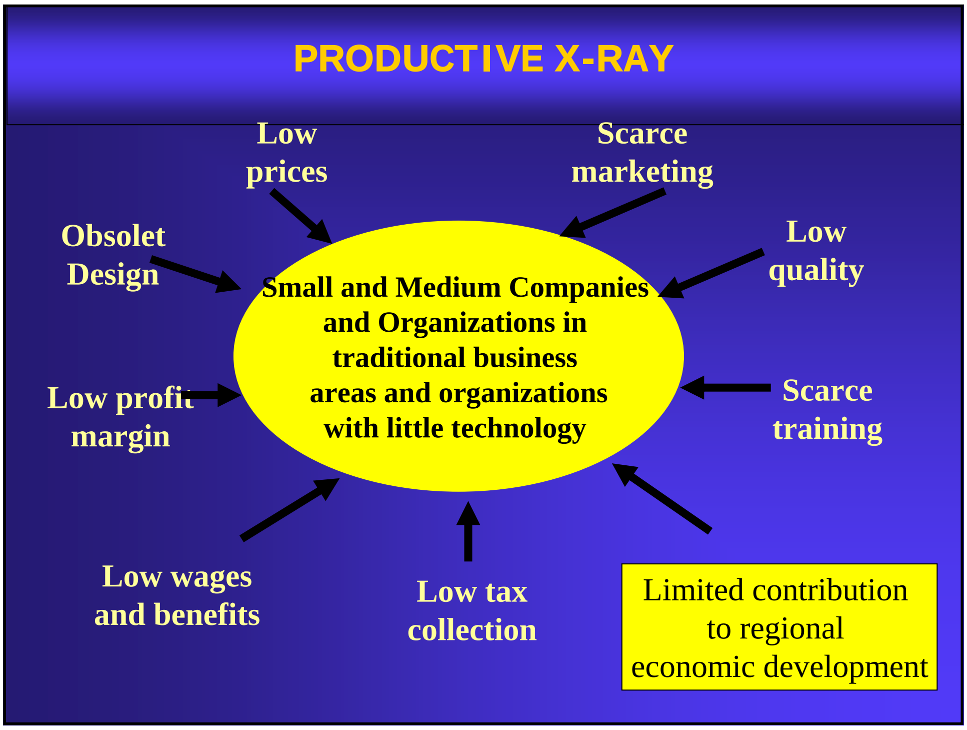
- For companies to design **cooperation mechanisms to create new products, to integrate production processes,** to make good use of economies of scale in the production sector, to transmit information and economic growth.

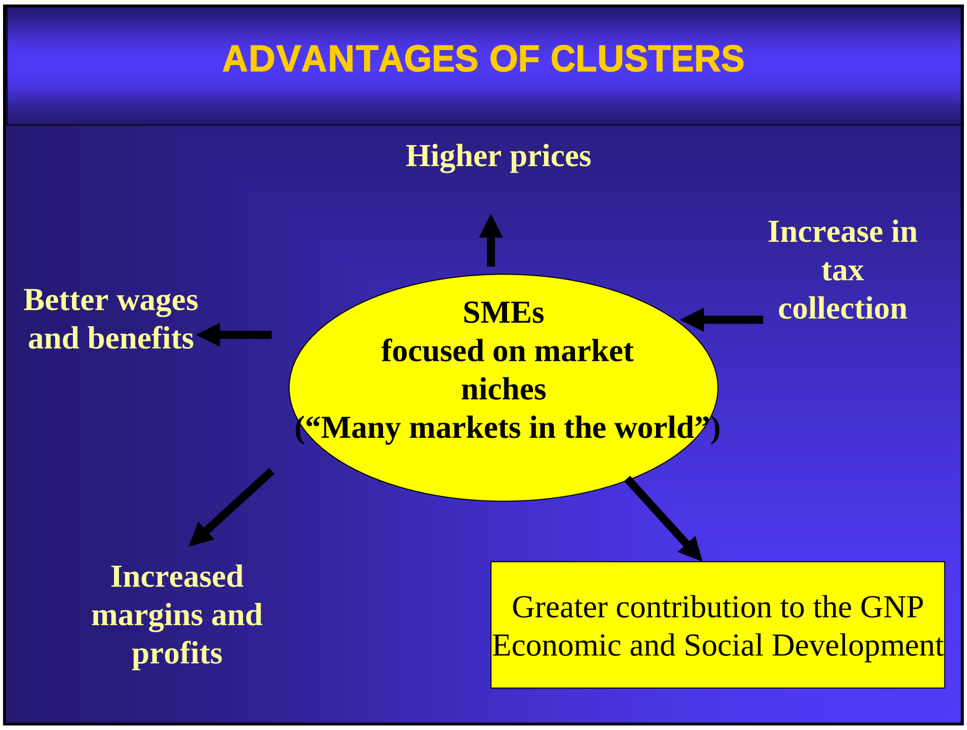
Sectorial Focus vs. Cluster Focus

Sectorial Focus	Cluster Focus
•Group with similar positions in the network	•**Strategic Groups** that are most complementary and that have different positions in the network.
•The analysis centers on final product companies.	•Includes **consumers, suppliers, rendering services and specialized institutions.**
•It concentrates in final product industries.	•Includes establishing **industrial relationships when sharing technology, skills, abilities, information, prime matter consumers and common channels.**

Sectorial Focus vs. Cluster Focus

Sectorial Focus	Cluster Focus
•Insecure when operating with rivals	•**Interrelated industries that share a common technology, abilities, information, prime matter and consumption channels.**
•Agreements with the government that limit rivalries, generally related to the establishment of subsidies .	•Great importance to improve in areas of common interest, which increases productivity and increases competition. •Creation of **constructive fora and greater efficiency to establish agreements with the government.**
•Seeks diversification on the same trajectory,	•**Seeks to create synergies.**


PRODUCTIVE X-RAY
Low prices
Scarce marketing
Obsolet Design
Low quality
Small and Medium Companies and Organizations in traditional business areas and organizations with little technology
Low profit margin
Scarce training
Low wages and benefits
Low tax collection
Limited contribution to regional economic development


ADVANTAGES OF CLUSTERS
Higher prices
Increase in tax collection
Better wages and benefits
SMEs focused on market niches ("Many markets in the world")
Increased margins and profits
Greater contribution to the GNP Economic and Social Development

CLUSTER MODELS

	Diversified Clusters	Sub-contract Clusters
	Many companies MIPYMES	Direct agreements with Big Companies
Directed by the buyer Intensive Goods in Capital	**Hand craft Industrial Districts** Example. Shoes in Italy	**Disgregation of Production Networks** Example. Assembly of consumption microelectronics in Korea
Directed by the manufacturer Intensive Goods in Technology and Capital	**High Technology Complexes** Example Silicon Valley in the United States	**Centers Based on Big Firms** Example. Mechanic engeneering in Baden Wuttemberg

PREMISES ON CLUSTERS

Clusters represent an opportunity for Small and Medium Companies that want to stay in the market and / or compete at an international level.

Clusters are mostly made up of Small and Medium Companies which provides flexibility and allows them to adapt to changes outside the country.

PREMISES ON CLUSTERS

There are a great number of industrial conglomerates of different sectors that are located in certain regions but have not been able to achieve a common development strategy due to:

- A mistaken belief that competition is among them.
- They cannot acknowledge that the competitors are international companies that work with several long term cooperation plans.
- Lack of knowledge on the importance and opportunities derived from globalization.

WHAT ARE CLUSTERS ?

BEFORE:

Group of industries that established themselves in well defined geographical region.

WHAT ARE CLUSTERS ?

TODAY:

A cluster is defined better by its functions than by its products. Instead of only relating companies of one specific economic or industrial sector located in a geographical area, today these companies cluster around suppliers of prime matter, type of technology, strategy, type of buyers and even because of competitors from other industries.

Gathering in clusters allows to capitalize economic relations between specific industrial sectors and provides the way to help define the economic development strategy for a region.

IMPORTANCE OF ENTREPRENURIAL GATHERINGS (CLUSTERS)

1. Production chains are concentrated by region.
2. International experience has shown that local economies that develop under the entrepreneurial concept (clusters) have increased significantly their competence in international markets.
3. The creation of a group of companies attracts productive factors in favorable conditions of quality and price, which reinforces the competitiveness of the cluster.

IS THERE A UNIVERSAL METHODOLOGY FOR DEVELOPING A CLUSTER?

NO.....

Different methodologies have been developed world-wide, because there are several cluster classifications and each one is unique.

WHAT IS THE AVERAGE TIME TO CREATE A CLUSTER?

It depends on the maturity of the companies developing the cluster. It is not possible to determine when the cluster is finished because there are always new projects to develop.

HOW CAN YOU BECOME PART OF A CLUSTER?

First you must analyze the characteristics of the cluster you want to join because additional companies must contribute to improve the cluster's competitiveness and they must be able to finance the association by themselves.

HOW ARE CLUSTERS CREATED?

Considering the importance and complexity of creating a cluster, its implementation requires the development of methodology and training through seminars that favor the creation of clusterizing agents that take charge of identifying, planning, creating and establishing regional clusters.

WHAT PROBLEMS EXIST ?

Un-trained staff promoting and consolidating clusters

There are no standard criteria for promotion

Lack of understandable information for company owners

PROBLEMS

High cost of consultants specialized in clusterization

No specific programs for clusterization exist

WHICH ISSUES MUST BE SOLVED ?

Training strategy must be directed to entrepreneurs, executives, advisors, consultants and must emphasize the following issues:

- Basis of Competitiveness and Clusters (principles and components of a cluster)

- Construction of Competitiveness (strategies to make competitiveness more efficient through commercial aptitudes and strategic positioning.)

WHICH ISSUES MUST BE SOLVED ?

- Methodology to create Clusters (establishing methods and procedures to create a regional cluster)
- Clusterization Proposals (identifying and creating a project bank and business plans)
- Competitiveness Plan (establishing a plan that guarantees success in the creation and operation of a cluster)

WHO PARTICIPATES IN A CLUSTER ?

A clusterization project requires the coordinated participation of several actors of the public and private sectors, as well as other organizations whose main activity is productive integration and the development of entrepreneurial networks. :

- Entrepreneurial Sector
- Educational Institutions
- Key and Sector Entrepreneurial Chambers and Associations
- Financial Institutions and Development Banks
- Non-government Foundations and Organizations
- Federal, State and Municipal Government

HOW TO DO IT ?

Design an economic development strategy to consolidate smaller sized companies, strengthening the productive chain so as to :

- Make good use of regional productive vocation establishing a medium and long term strategic vision.

- Strengthen production chains to transform them into detonators of regional development.

IMPLEMENTATION STRATEGY

- Achieve a shared vision of all economic agents involved in the development of industrial clusters.
- Relate and establish support mechanisms (tax and credit stimulation, training, technology and infrastructure), to facilitate the development of entrepreneurial clusters.
- Increase companies' levels of competitiveness by integrating them into productive chains.

WHAT BENEFITS DOES IT PROVIDE ?

- Improvement of the productive chains

- Maximization of the companies' efforts

- Capitalization of economic relationships between specific industrial sectors.

- Better definition of the region's economic development strategy.

WHAT BENEFITS DOES IT PROVIDE ?

- Achieve a shared vision of all economic agents involved.
- Create a greater economic distribution in the region or in the area of influence.
- Provide prestige to a determined region when manufacturing a better quality product.
- Fast response to changes in the industry.
- Strengthens the production chains.

WHAT BENEFITS DOES IT PROVIDE ?

- Make good use of regional production vocations by establishing medium and long term strategic planning.
- Increase levels of competitiveness among the companies by integrating them into production chains.
- Create scale economies in the group's activities.
- Achieve specialization of companies in the manufacture of products, processes and machinery related to the activity.

CONCLUSIONS

Steps to accelerate clusterization:

- **Increase the Critical Mass of Entrepreneurs.**
- **Design programs with good methodologies that provide entrepreneurs with experience in business.**
- **Promote the efficient installation and operation of new business incubators.**
- **Implement a regulatory and Tax scheme that is simple and that encourages the start of new companies (in incubation process) as well as the operation of Risk Capital Funds.**
- **Seek technological innovations with the possibility of doing national or international business. ("Start Ups").**

CONCLUSIONS

Areas of Opportunities with a Technological Basis:

- Medicine and Food / Biotechnology (bioengineering; genomic)
- Information Technologies; Software; Multimedia
- Telecommunications (intelligent personal communications / Digital Networks)
- Internet & Electronic Commerce
- Robotics CAD/CAM
- Safety, Control and Testing Equipment
- Electronics
- Energy

CONCLUSIONS

Areas of Opportunities with a Technological Basis:

- Electro optic equipment
- Semiconductors
- Transport Technologies
- Medical Equipment
- New materials and Intelligent Materials
- Environmental Technology
- Nanotechnology

THANK YOU FOR YOUR KIND ATTENTION

How SMEs benefit from industrial clustering in Peru;
A case study from the metalworking sector

Sandra van Hulsen[1]

Paper for the APEC symposium “Industrial Clustering for SMEs” on 8 and 9 March 2005, in Chinese Taipei

1) Introduction

In Peru more than 65%[2] of the enterprises are small or micro enterprises (SMEs). They provide a substantial part of the products and services to consumers and other -most medium and small- companies in the region. Some of them even sell their products to clients in other parts of the country or abroad. Additionally these SMEs offer a substantial part of the jobs in the country (70%)[3], not only for the entrepreneurs themselves and their families but also for other employees. Eventually not all entrepreneurs started their business voluntary, a lot of them lost their jobs when big companies vanished during the trade-liberalisation in the 90-ties, but they more or less generate an income and support the development of the national economy (43% of GNP[4]).

Some SMEs are concentrated in specific geographical areas, specialising in a related set of manufacturing and service activities. Those companies additionally seem to show signs of economic resilience and, in certain cases, also dynamism based on co-operation between firms, local support institutes, universities and government in so called ‘clusters’ of SMEs (MITINCI 1994, Visser 1996 and 1999, Cornejo 1998).

Peruvian policy makers actually neglected the potential of SMEs for a long time. The arrival of a new government in 2001 changed this situation, renewing the discussion among SMEs, big enterprises, local, national and international support institutes and universities about alternative ways to stimulate small enterprise development and promoting dynamic clustering advantages. In this framework the International Labour Organisation (ILO) executed an in-depth study in two locations with a concentration of SMEs from the same industrial sector in 2001, to explore the dynamics of clustering and the way this could be stimulated in order to enhance the performance of the SMEs involved. The first location was the Infantas district in Lima with a concentration of metalworking businesses and the second location was Ayacucho with a concentration of

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[1] Van Hulsen Consulting, Gruttomeen 120, 3844 ZH Harderwijk, the Netherlands,
E-mail: sandra-van-hulsen@riechard.net.
Sandra van Hulsen currently works as director/consultant in the areas of organisational development, development of small and medium enterprises, job quality and communication. From 2000 until 2002 she worked for the ILO Sub regional team for the Andean countries in Peru and managed -among others- a project on the development of industrial clusters in Peru. From 1998 until 2000 she worked for UNIDO in Indonesia and managed a project with the same objective.

[2] IADB, María Orlando and Molly Pollack in Las Microempresas y la pobreza, perfil de América Latina (Microenterprises and poverty, Latin American Profile) in: ILO and Swisscontact, 2001

[3] ENAHO 1990, 1995, 2000, in: Gutiérrez L. and Van Hulsen, 2001

[4] INEI 1998, in: Gutiérrez L. and Van Hulsen, 2001

handicraft producers (Gutiérrez L. and Van Hulsen 2001; Hernando and Van Hulsen 2001; Van Hulsen, Gutiérrez L. and Hernando 2003).
This paper aims at reviewing the metalworking case to determine the way these SMEs experienced benefits from the dynamics of industrial clustering. Through this example I like to add practical learning experiences to existing theories and ideas about clustering and motivate other SMEs and stakeholders involved to search for possibilities to strengthen industrial clustering to enhance performance and income for the entrepreneurs and employees involved.

The paper is structured in the following way: first I present the theoretical framework used (section 2). In section 3 the metalworking cluster in Infantas, Lima is being reviewed and in section 4 I evaluate the results and draw conclusions.

2) Conceptual framework

The definition of clusters used in this paper is: a group of enterprises that concentrate in a specific geographical area, are specialised in one industrial activity, show dynamics of cooperation and competition and who maintain relationships not only with clients and suppliers but also with institutes in their environment.
This definition implies the following aspects are taken into account:

- the development of SMEs as a group;
- the development of the relations among the enterprises and other actors in the vicinity; and
- the value chain- relations of enterprises with their clients and suppliers

The basis for this concept is the concept of ‘industrial districts’ as described by Becattini in 1979. He concluded that a group of enterprises, interrelated and located at a geographically limited zone, should be studied as a unit in total instead as separate enterprises (San Martín B., 1995). Pyke, Becattini and Sengenberger (1990) added that the success of these ‘industrial districts’ or ‘clusters’ not only depends on economic aspects, but also on social and institutional aspects. In relation to a more recent discussion on clusters as part of a value chain and industrial networks (Meyer-Stamer, 1998), the dimension of external relations with clients and providers was being added. Finally, based on experiences in local economic development (Van Boekel 1992, PROMDE 2001, DelNet and Aster 1999), also influences of external stakeholders were taken into account.

The aspects examined in the study, which was executed in 2001 were determined on basis of an evaluation of instruments used in existing studies on clusters (Nadvi & Schmitz 1994, San Martín B. 1995, UNIDO 1998, Visser 1999 and Sandee & Van Hulsen 2001), value chain analysis (Kaplinski 2000, IDS[5]) and local economic development (Van Boekel 1992, PROMDE, 2001). The

[5] see also www.ids.ac.uk

following aspects, being measured during the study, were mentioned as benefits that contributed to the success of clusters:

- commercial efforts
- technological innovation
- use of quality standards
- easy access and quality of raw materials and services
- socio cultural framework
- characteristics of the entrepreneurs
- development policies
- financial services; and
- business development services.

An own addition was:

- ‘cohesion’ in the cluster to measure cooperation among entrepreneurs and stakeholders.

And later on also:

- ‘availability of a qualified workforce’ was being added.[6]

As indicators to measure the level of success of the cluster were studied:

- level of income (measured by monthly sales, perception of profit and profit compared to the years before;
- employment (number of employees, education level, working hours, salary, employment growth rate, rotation and recruitment)
- productivity (labour-, machine-, material- and total productivity measured in value and capacity used of installed machinery); and
- job quality (job security, social protection, occupational safety and health, human resource development, management and organisation, gender equality).

To be able to classify the development of the cluster the following three-phase model was being used. This model also indicates which aspects need to be stressed to be even more successful as cluster (San Martín B. and Van Hulsen, 2002):

a) A cluster with ‘family enterprises’ who are hardly capable of developing their potential and in general only ‘survive’;
b) A cluster with enterprises who are in the position to accumulate capital, have a better technical infrastructure and qualified staff, and can enhance their production by inter-firm relationships;
c) A cluster that consist of enterprises that offer quality, have strong relationships with other enterprises, utilise the advantages of joint promotion, are innovative and orient themselves at highest levels of the market (e.g. export).

[6] For background purposes other aspects were measured as well: historical development of the cluster, local and national economic development, variety of products, problems as perceived and strategies applied by the clusters and the influence of the diverse stakeholders.

Additionally practical experiences and insights of the entrepreneurs and stakeholders were being used. The interaction about these aspects was facilitated by the nature of the investigation, since it was a participative research that not only was based on surveys, but also consisted of individual discussions with stakeholders and three meetings with representatives of the cluster.

The evaluation of applicability of these aspects will be reviewed in the following section, section 3.

3) Metalworking in Lima

The cluster in metalworking is located in the Industrial Park Infantas in the District Los Olivos in the northern part of Lima. The cluster exists since the seventies. By then the industrial park was being established as a result of urban planning. The combination of the availability of plots for small enterprises, the possibility to live in the same area, and the presence of some big clients in the form of assembly plants for automobiles like Ford and Chrysler proved to be a good basis for growth of the cluster. Although these assembly plants had to close their doors at the end of the eighties, the cluster surprisingly continued to grow,.
In 2001 the cluster consisted of 214 industrial enterprises dedicated to a variety of products in metalworking (metal furniture with wooden components (30%), machines and equipment (22%), small metal articles (11%) and others (37%)), next to 30 shops and 11 enterprises who delivered services to the industrial enterprises. Additionally strong relationships existed with:

- a variety of clients within (20%) and outside the cluster (56% to other parts of Lima, 22% to other provinces in Peru, and 2% to export markets (Ecuador, Venezuela);
- a few big and a lot of small suppliers of which the latter mostly were located in the cluster;
- a few technical institutes (4) located in the area, where most entrepreneurs studied and staff was being recruited;
- a municipality facilitating fairs and organising short training courses;
- a few bancs delivering financial services to some entrepreneurs; and
- two associations of entrepreneurs: one with 53 members from the metalworking sector in the district Los Olivos and neighbouring district Comas (a bigger area than Infantas alone) and one for all enterprises in the industrial park Infantas (not only metalworking companies).

Surprisingly enough until 2001 hardly any business development services were being provided apart from the few courses and events organised by the municipality. By that time however, one of the technical institutes (SENATI), started to look for a market in providing vocational training or short courses to small businesses in Infantas. And other institutes started to follow, triggered by the local association of metalworking entrepreneurs (ATEM) and the ILO investigation.

The entrepreneurs working in the cluster of Metalworking in Infantas experienced the following benefits:

- ***Qualified and young fellow-entrepreneurs and availability of a social cultural framework**:* 73% Of the entrepreneurs participated in university or higher technical education and most of them are between 26 and 39 years old. The entrepreneurs themselves regard these aspects as an interesting basis to cooperate for a longer period of time. It can be added that most entrepreneurs know each other because they studied at the same technical university, which seem to provide a stable cultural framework.
- ***Qualified workforce available**:* A specialised workforce is available since a lot of students graduate at one of the technical institutes in the area (60% participated in a (technical) secondary school and even 30% higher technical education), although these students additionally need an intensive training on the job before being productive. As a result most of these employees have a permanent contract (65%). And only in a few cases entrepreneurs frequently change their employees (10%), which is very low for Peru in comparison to other sectors and other regions. And if employees need to be laid off (because of long periods of time with low demand) it costs some effort to find new employees. The entrepreneurs assist each other by providing recommendations to employees;
- ***Easy access to services (and raw materials**):* The availability of other metalworking and related enterprises for provision of services: 40% of the entrepreneurs subcontract part of their work like cutting, foundry, painting etc, of which 90% within the cluster. Also most providers of raw materials (mainly distributors) are closely located to the cluster in the northern part of Lima;
- ***Technological innovation**:* The majority of enterprises changed its production process during the last three years, based on their own experience or exchange of ideas with friends from the metalworking cluster, their staff, clients and family. It seems even 42% of the entrepreneurs permanently or frequently exchanged ideas and information about technical aspects of production and new products;
- ***Cohesion***: 27% of entrepreneurs experience benefits because they joined in organised communal activities of entrepreneurial type. Additionally 49% of them participated in social, cultural and sport events. Partly as a result of this –as stated before- 42% of them exchange ideas and information about production and products and 40% subcontract part of their work to others. On top of this approximately 25% of the entrepreneurs join in one of the two associations, of which one of them is actively working on an enhanced availability of business development services to obtain certification in ISO 9000 and increase export. (Others complain of the exclusivity of this association, since cooptation is being applied);
- ***Commercial effects**:* In general the entrepreneurs experience some advantages by being known as an area being specialised in metalworking. The producers of Metal furniture with wooden components are a positive exception to this, since they experience a large commercial effect. They are the ones who sell their products to final consumers in shops in front of their

houses, mostly located along one busy street in Infantas. The other producers do not have an exhibition space available. (41% Of total sales of the cluster is being sold to final consumers, 42% to commercial intermediaries, 13% to national subcontractors and 4% to commercial exporters). An aspect that contributes to the positive commercial effects is the accessibility for potential clients, since the cluster is located next to the Pan American Highway, and additionally close to an international harbour (Callao, Lima) and an international airport (Jorge Chavez, Lima) .

Comparing with general theoretical insights about contributing factors to success of clusters (as described in section 2) it seemed a lot of factors were present in the cluster in Infantas. The factors that were lacking are:

- sufficient commercial effects;
- frequent use of quality standards;
- quality of some raw materials (this counts especially for the producers of Machines and equipment for the agricultural and food sectors. They are lacking availability of non-corrosive metal in Peru, so they are using a lower quality of materials instead or pay a high price for imported raw materials);
- clear development policies;
- sufficient financial services; and
- sufficient business development services.

The entrepreneurs themselves confirmed they were missing sufficient commercial effects (and also too little commercial efforts were shown (there was especially too little information about market demands)), quality of some raw materials and business development services, but did not mention financial services, quality standards or development policies. Instead they pointed out:

- the poor situation by technical obsolete equipment in the enterprises (unless the high level of technological innovation and subcontracting); and

See also table 1 for an overview.

POTENTIAL BENEFITS	PRESENT IN INFANTAS
Commercial effects	+/-
Technological innovation	+/-
Use of quality standards	-
Easy access and quality of raw material and services	+/-
Socio cultural framework	+
Characteristics of the entrepreneurs (qualified and young)	+
Qualified workforce	+
Development policies	-
Cohesion	+/-
Financial services	+/-
Business development services	+/-

Table 1: Benefits experienced in the cluster in metalworking in Infantas, Lima (own elaboration)

The benefits found in Infantas resulted in the following for the entrepreneurs and employees in Infantas:

- *Level of income:* Most entrepreneurs (60%) indicated their profits had decreased in comparison with the years before, although the majority still perceived these profits as regular (63%). Others even had the opinion that profits were good (15%) and unfortunately 22 % did not have any profit at all. The exact level of income which was also being measured, but is only interesting to compare with data from the same group of enterprises in future.
- *Employment:* The average amount of employees per enterprise was 6,5 (1,400 employees in total).[7]
  65% Of the metalworking employees in Infantas had a permanent and 27% a temporal assignment which is quite an unusual pattern in the metalworking branch (14% had a permanent contract in Lima (ILO and Swisscontact, 2001)) and in general in Peru (25% had a permanent contract in all sectors in Peru, Chacaltana, 2001). Additionally 71% of these employees are non-family members, which was also quite exceptional.
  The average amount of salary was USD 194, which was high in comparison to Lima where 74% of the employees earn less than 170 USD. The salary is also above the minimum wage of USD 124 (or S/. 420 in 2001) and higher than the underemployment line of USD 170. At the other hand employees in the cluster experienced longer working hours than in metalworking in general in Lima (54 hours versus 46 hours, that is higher than the maximum established by Peruvian law of 48 hours (ILO and Swisscontact, 2001)). Further more it is remarkable that women in all function categories for the same working hours earned less than their fellow male employees in Infantas. In Lima as a whole 87% of the cases women and men are paid the same amount for the same job (although it could be this figure is influences by the idea of social acceptable answers) (ILO and Swisscontact, 2001). Fortunately no child labour exists in the cluster (in general child labour in small enterprises in Lima exists, but it is quite low).
  Employment growth rate was -0,5 on average, which was in line with the national trend. Only the product group of Vehicle body frames had known a slight increase (0.4) in the last five years, because of the recent popularity of motor taxis in Lima.
- *Productivity:* Total productivity is the highest in the product group of Small metal articles (3,22)[8]. We also measured the several components of total productivity, but this data is only interesting to compare with data from the same product group in the future. The most intensive use of installed capacity existed in Metal furniture with wooden components (72%), Foundry (58%) and Vehicle body frames (52%). The rest of the equipment is being used less than 50% of work time. The average in Infantas is 47%).

[7] In Peru in general it seemed in formal small enterprises the employment was 9 employees on average in 1999 (Chacaltana, 2001), but we have to take into account most small enterprises are informal and smaller, so this figure is quite high and therefore difficult to compare with the figure in Infantas.
[8] Total productivity is being measured in value, so sales divided by the costs of labour, machine maintenance and raw materials in the month October 2001.

Unfortunately no data is available for comparison from metalworking enterprises in Lima, small enterprises in Lima or small enterprises in Peru.

- *Job quality:* The work environments and occupational security and health were quite good in comparison to other small enterprises in Lima (ILO and Swisscontact 2001, Van Hulsen and Visser 2003): almost all enterprises counted on workshops of solid material, had toilets and changing rooms available for employees. Further more half of the entrepreneurs indicated security zones in case of earth quakes and different type of protective equipment were provided to the majority of employees. At the other hand it would be necessary to provide training in occupational safety and health to employees. Regarding social security it would be necessary to provide more attention to health insurances, insurances for accidents and pensions, although it level was already better than the rest of Lima (41% of the entrepreneurs in the cluster paid for health insurance for their staff in comparison of 10% for the rest of Lima; and 29% contributes to pensions in comparison to 0% for the rest of Lima). Although this is promising, it still does not comply with the 100% obligation by law. A positive sign was a large part of the entrepreneurs were thinking about improving these social security aspects.

Comparing the indicators for the level of success in Infantas with general data about those levels in individual enterprises the following can be concluded: we found a more stable employment even to non-family members than for individual enterprises in metalworking in Lima, small enterprises in Lima or in general in small enterprises in Peru. Also a higher remuneration level could be found, although the employees were working longer hours. Gender equality does not seem to exist since all women are paid less for the same kind of work for the same hours in the contrary to the rest of Lima, where most women were paid the same. A positive difference is no child labour is being seen in Infantas. Also job quality is better in Infantas than the rest of Lima, with respect to work environment, occupational safety and health and social security, although it still does not comply with national law. The level of success in the metalworking enterprises in Infantas is general higher than that of individual small metalworking enterprises in Lima and small enterprises in general in Lima, so this seems to support the general theoretical assumption that enterprises in clusters perform better than enterprises individually.

Furthermore we can say the cluster of metalworking in Infantas is a cluster of ‘type b’, with enterprises who are in the position to accumulate capital, have a better technical infrastructure and qualified staff and who can enhance their production by inter-firm relationships (see also section 2).
Since entrepreneurs and stakeholders involved were interested to move to the next stage (type c), that implies that enterprises offer quality, have strong relationships with other enterprises, utilise the advantage of joint promotion, are innovative and orient themselves a highest level of marketing.

In the strategic planning, that was part of the investigation it was being decided by the parties involved to invest especially in the following activities:

1. Intensify marketing activities to access to national and international markets, via e.g. business development services, information and cooperation;
2. Improve equipment, machines, processes and work environment, via e.g. business development services and shared use of equipment ;
3. Improve quality of raw material for an acceptable price, via e.g. cooperation and development of quality standards; and in general
4. Intensify co-operation among enterprises, with clients, providers and institutions and organisation of strategic coordination or development policies.

During the period of the participative research (September 2001-May 2002) the following progress in these activities was already being made:

Ad 1) Intensify marketing activities:

- Organisation of a training in commercial themes and international business trips by the national public institute for promotion of export (PROMPEX);
- Organisation of training in total quality management by the Ministry of industry, tourism, integration international commercial negotiations (MITINCI);
- A first edition of a directory of enterprises, realised by students of a nearby university (UCSS);

Ad 4) Intensify co-operation and organisation of strategic coordination or development policies:

- The first meetings and discussions about a joined platform on economic coordination, organised by the researchers (ILO);
- A basis for a joined policy, by having available a base line study of the cluster and joined strategic goals for further development, coordinated by the researchers (ILO);
- Continued enthusiasm by the association of metalworking entrepreneurs (ATEM) and the municipality to organise strategic coordination; and enhanced enthusiasm of the other stakeholders involved.

Additionally a variety of stakeholders showed their interest to contribute to the development of the cluster.

Two years later, in June 2004, the following activities were being realised:

Ad 1) Intensify marketing activities:

Especially in this aspect a lot was being invested. In addition to the first activities several business development services in marketing and export were being provided by, among others: the national organization for promotion of the small and micro enterprise sector of the Ministry of labour and promotion of employment (PROMpyme) and the association for exporters (ADEX), participation in courses in cost control took place via a programme of the ministry of employment (BONOPYME); and several entrepreneurs participated more than before in national and international fairs, supported by PROMPEX and ADEX.

Ad 2) Improve equipment, machines, processes and work environment:

It was being agreed that several universities/institutes (UNAC and CEPEA) provide interns to do investigation and gain practical experience in the diverse enterprises in metalworking in Infantas, which not only contributes to application of modern insights to technologies applied in the cluster, but also to the forming of better equipped future employments. On top of it, the association ATEM is being recognised as a centre of technological innovation (CITE) in 2004 and provides technological and administrative services to enterprises in Infantas, stimulated by available funds for this purpose (Neyra 2005). So equipment, machines, processes and work environment can be improved and equipment and machines will be available for other entrepreneurs in the cluster, who have no funds to buy these machines themselves.

Ad 3) Improve quality of raw material for an acceptable price:

In the end no negotiation took place with several big suppliers about quality and price nor a discussion took place with the national quality standard institute about quality norms, although they had shown interest during the time of investigation. But better quality of raw materials are also planned to be reached in the framework of the CITE (see ad 2) were several tests will be done on raw materials and constructions in addition to the activities with an eye on improvement of equipment, machines processes or work environment.

Ad 4) Intensify co-operation and organisation of strategic coordination or development policies:

Especially the association of metalworking entrepreneurs (ATEM) continued organising and coordinating diverse activities of several institutes in the area and Lima and enhanced their strategic coordination by formulating a strategic plan. Additionally they intensified the cooperation among some enterprises that are a member and formed two networks: one in equipment for electrical distribution (with 12 enterprises and 225 employees) and one in sprinklers for the agricultural sector (with 4 enterprises and 62 employees). Enterprises who like to join ATEM actually need to participate in a course of total quality and a course on exportation. The Municipality of Los Olivos did not facilitate the strategic coordination in the end, although they were willing to do so, because of the replacement of the person who was actively involved. Also promotion of entrepreneurship proves to be human in its nature in the end.

To measure the effects of these activities it would be interesting to organise another detailed study on the same aspects of the metalworking cluster in Infantas as measured before in 2001 by ILO, to see exactly which benefits are being experienced right now and which ones changed and which results are being reached.

Aspects that are being studied recently (Gutiérrez L. 2004) are the effects of commercial efforts by the level of export (international sales) in comparison to national sales and the investment in technology of enterprises who are a member of the association in metalworking ATEM (see table 2). At the moment approximately 30 entrepreneurs are a member of ATEM and this group is of course only a part of the total cluster of approximately 250 enterprises. Nevertheless it is interesting to see some results of a part of the cluster, which might have its effect on the results of the development of the cluster in general.

YEAR	INVESTMENT IN TECHNOLOGY US$	NATIONAL MARKET US$ +(% of total sales)	INTERNATIONAL MARKET US$+(% of total sales)	TOTAL SALES US$
2000	0	4,410,000 (98%)	90,000 (2%)	4,500,000
2001	0	9,800,000 (98%)	200,000 (2%)	10,000,000
2002	200,000	17,640,000 (98%)	360,000 (2%)	18,000,000
2003	300,000	24,500,000 (98%)	500,000 (2%)	25,000,000
2004	250,000	49,000,000 (98%)	1,000,000 (2%)	50,000,000
2005	100,000	63,700,000 (98%)	1,300,000 (2%)	65,000,000
2006	150,000	98,000,000 (98%)	2,000,000 (2%)	100,000,000

Table 2: Total of sales in national and international market (estimated by ATEM in 2004)
Source: Own elaboration based on Gutiérrez L., 2004

As we can see in table 2 in 2002, 2003 and 2004 large investments were being made in technology, probably in the framework of becoming a CITE. The total value of sales increased drastically between 2001 and 2002 and between 2003 and 2004. Sales in the international market is also growing in absolute sense, but the percentage of the total sales remains the same. We can conclude all efforts and objective of ATEM to grow in the international market in absolute sense becomes true, but sales to the national market grows in the same pace. We can conclude however that the aspect of enhanced export in absolute sense, which is part of 'type c' clusters, is within reach for a part of the cluster.

4) Conclusions

It seems a lot of factors contributing to the success of clusters are present in Infantas. A few factors were lacking however: sufficient financial and business development services, sufficient use of quality standards, quality of some raw materials, clear development policies and commercial efforts.
The entrepreneurs themselves confirmed they were missing sufficient business development services, quality of some raw materials and commercial activities, but did not mention financial services, quality standards or development policies. Instead they pointed out another factor: the existence of technical obsolete equipment in the enterprises (unless the high level of technological innovation and subcontracting).
After two years it appeared the factors that the entrepreneurs did not mention were not being improved and recommendations in this field were not being followed. The other recommendations in which the researchers and entrepreneurs coincided, improvement was being made indeed (like the forming of two business networks oriented to export). So it is important to add certain suggestions on basis of theory and experiences elsewhere, but also to take into account the views of the actors involved, since they are in the end the ones having most influence and interest in results.

Comparing the indicators for the results or level of success in the cluster Infantas with general data about those in individual enterprises in metalworking in Lima and all small enterprises in Lima it can be concluded that the cluster is more successful, so this supports the general theoretical assumption that enterprises in clusters perform better than enterprises individually. We found for example a more stable employment even to non-family members; a higher remuneration level, although the employees are working longer hours; no child labour; and a higher job quality (work environment, occupational safety and health and social security), although it still does not comply with national law. A negative exception is gender equality: all women working in the cluster in Infantas are paid less for the same kind of work for the same hours in the contrary to the rest of Lima, where most women were paid the same.

Furthermore we can say the cluster of metalworking in Infantas is a cluster of 'type b', with enterprises who are in the position to accumulate capital, have a better technical infrastructure and qualified staff and who can enhance their production by inter-firm relationships.
The cluster seems to move to type c, through the intensive cooperation, especially in the association in metalworking and an enhanced level of export in absolute sense.

It is furthermore remarkable that a lot of institutions are willing to provide their assistance to the cluster. Apart from interest the institutions located in the cluster probably feel a certain kind of social obligation. Other national institutes located outside the cluster in Lima probably also might want to participate in a success story which is within their reach.[9]
An important factor for the success of the cluster however seems to be the enthusiasm of the association in metalworking, since they are the motor behind a lot of the activities supported by the several institutions mentioned and transformed the input into results. It only has to be taken care of that the benefits not only count for those entrepreneurs who are a member of the association, but also for other entrepreneurs in the metalworking cluster in Infantas.

Bibliography

1. Boekel, G. van and M. van Logtestijn, "Applying the comprehensive LED approach"; the case of Mozambique", ILO, 2002;
2. Chacaltana, Juan, "Políticas públicas y empleo en las pequeñas y microempresas en el Perú" (Public policies and employment in small and micro enterprises in Peru), ILO, 2001;
3. Cornejo, C., "Sistemas de producción y cooperación en la aglomeración de la industria textil y confecciones en Gamarra, La Victoria, Lima, Perú"

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[9] In this case it does not seem to result in problems, but of course we have to be careful no funds are being spoiled, since other clusters and enterprises are also interested in support.
It can be discussed if it is better to assist enterprises who are already growing and have a stronger basis for further growth or assist the poorest and smallest enterprises. The latest views are that assistance to all with applicable tools would be in favour, but assistance to the first will probably have a larger effect in the end.

(Production and cooperation systems in the textile and garment aglomeration in Gamarra, La Victoria, Lima, Peru), PhD dissertation, University of Geneva, 1998;
4. DelNet & ASTER (Agencia per lo sviluppo tecnologico dell'Emilia Romaña), “La región Emilia Romaña, Italia y el sistema ERVET; una experiencia integral y concertada de desarrollo regional” (The Emilia Romaña region, Italy and the ERVET system; an integrated experience of regional development), International training centre of the ILO, 1999;
5. Gutiérrez Lozano, Helbert and Sandra van Hulsen, “Investigación del cluster de pequeñas empresas de Metal mecánica de Infantas, Los Olivos-Lima; sus características y potencial de desarrollo” (Investigation of the Metalworking cluster in Infantas, Los Olivos-Lima; its caracteristics and development potential), ILO, Lima-Peru, 2001;
6. Gutiérrez Lozano, Helbert, “Las redes empresariales especializadas de la asociación ATEM Peru; dentro del cluster de metal mecánica de la zona industrial de Infantas del cono norte de Lima metropolitana” (The specialised networks of entrepreneurs of the association ATEM Peru; in the cluster in metalworking in the industrial zone Infantas in the northern part of Lima), 2004;
7. Hernando, Nelly and Sandra van Hulsen, “Investigación del cluster de Artesanía en Ayacucho; sus características y potencial de desarrollo” (Investigation of the Handicraft cluster in Ayacucho; its caracteristics and development potential), ILO, Lima-Peru, 2001;
8. Van Hulsen, Sandra and Evert-Jan Visser, “Job quality and clusters of small and micro enterprises in Peru”; draft discussion paper for the EADI seminar in Amsterdam, The Netherlands, 17 and 18 January 2003;
9. Van Hulsen, Sandra, Helbert Gutiérrez Lozano and Nelly Hernando, “Promoting small enterprise clusters in Peru; two case studies from the metalworking and handicraft sectors”, ILO, accepted in 2003;
10. ILO and Swisscontact, “La Calidad del Trabajo en la Micro y pequeña Empresa en Lima, el Perú” (Job quality in micro and small enterprises in Lima, Peru), Lima-Peru, 2001;
11. Kaplinsky, Raphael, “Spreading the gains from globalisation: what can be learned from value chain analysis ?”; IDS Working paper 110, 2000;
12. Meyer-Stamer, Jürgen, “Clustering, systematic competitiveness and commodity chains: shaping competitive advantage at the local level in Santa Catarina”, Brazil, International Labour Studies, Geneva, 1998;
13. MITINCI, “Programa de pequeña y micro empresa: lineamientos de política” (Small and micro enterprise programme: political guidelines), Ministry of Industry, Tourism and International Negotiations, 1994;
14. Nadvi, K. and H. Schmitz, “Industrial clusters in less developed countries: Review of experiences and research agenda”, IDS Discussion Paper 339, Institute of Development Studies, Brighton –UK, 1994;
15. Neyra Olaychea, Angel, “Identificación de obstáculos técnicos para el acceso al mercado de los Estados Unidos, sector metal mecánica”

(Identification of technical obstacles for the access of the US Market, metalworking sector); project document for BIB-FOMIN, ATEM, 2005;
16. PROMDE, “Modelo de intervención para la promoción municipal del desarrollo económico local” (Model of intervention for the municipal promotion of local economic development), Peru, 2001;
17. Pyke, F, Becattini, G. and Sengenberger, W., “Industrial districts and interfirm cooperation in Italy”, International Institute for Labour Studies, Geneva, Switzerland, 1990;
18. Sandee, Henry and Sandra van Hulsen, “Business development services for small and cottage industry clusters in Indonesia; a review of cases from Central Java”, in: Small business services in Asian countries; market development and performance measurement, J. Levitsky, ITDG, UK, 2001;
19. San Martín Baldwin, Francisco, “Distritos industriales; conceptos, experiencias y bibliografía” (Industrial districts; concepts, experiences and literature), MINKA, Peru,1995;
20. San Martín Baldwin, Francisco and Sandra van Hulsen, “Plan de desarrollo del cluster de pequeñas empresas de metalmecánica en Infantas, Los Olivos, Lima; Red de valor” (Development plan of the cluster of small enterprises in metalworking in Infantas, Los Olivos, Lima; value chain), ILO, 2002;
21. UNIDO, “Draft cluster diagnosis and action plan; Yogyakarta area Leather goods cluster, DIY, Yogyakarta”, “Draft cluster diagnosis in Padang rattan industries and proponed action plan”, “Draft cluster diagnosis and action plan South Sulawesi coffee processing cluster” and “Draft cluster diagnosis in Kuningan fried union cluster and proposed action plan”, Jakarta, Indonesia, 1998;
22. Visser, Evert-Jan, “Local sources of competitiveness: spatial clustering and organisational dynamics in small-scale clothing in Lima, Peru”, PhD dissertation, University of Amsterdam, 1996;
23. Visser, Evert-Jan, “A comparison of clustered and dispersed firms in the small-scale clothing industry of Lima”, in: World Development, volume 27 number 9, 1999.

Small Business Clustering: The Benefits of Local Network Learning

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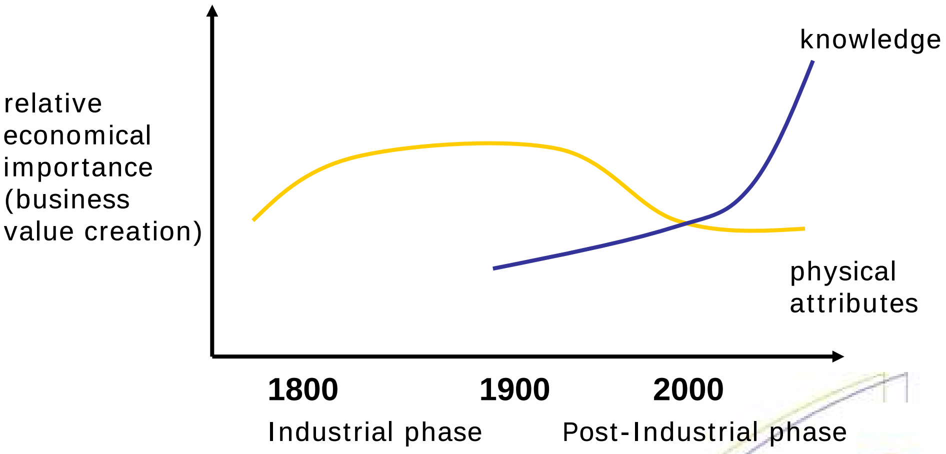
presentation overview

- Theoretical Perspectives on SME clustering
- Knowledge Creation and Knowledge Transfer
- Australian case studies
- Implications & Future Directions
- Q & A

from old to new economy



clustering/networking

- In the context of emerging technologies and related knowledge-economy business models, linking stakeholders in networks and dynamic clusters is believed to enhance competition and regional innovation(OECD, 1999, Porter 1998)

- The literature is saturated with views on geographic clustering of industries, companies and institutions (Asheim, 2001; Enright & Roberts, 2001; Krugman, 1995; Porter, 1990; Piore & Sable 1984).

what is a cluster?

- The geographic scope can vary from a single city, state or region to a network of companies across state borders or even country borders.
- Variety of clustering forms to optimise competitive advantage:
  - formal or informal
  - in the public or private sector
  - horizontal (share R&D, industrial, technological base or market & distribution channels
  - vertical (horizontal participants as well as supply chain members & services)
  - diagonal (complementary or symbiotic activities, whereby each firm adds value).

clustering vs. clusters

As industry clusters become more accepted, their definition, boundaries and composition become more complex, which has led some cluster researchers (e.g., Rosenfeld 2003, Enright, 2005) to focus on clustering activities rather than on clusters as such;

Presentation focus is on regional SME clustering activities with an emphasis on industry and place, regional relationships and local network learning.

clustering definition

Geographic co-location of activities that are linked horizontally, vertically, diagonally (and sometime virtually) along the value chain.

This co-location serves as an attractant to new companies wishing to access intelligent services and goods and facilitates knowledge transfer, either formally or through spill-overs.

clusters and industry

- Marshall's perspective
  - industrial districts–development of ancillary industry
  - Industry knowledge, customised product and processes
  - cultural fit
  - common processes and business models

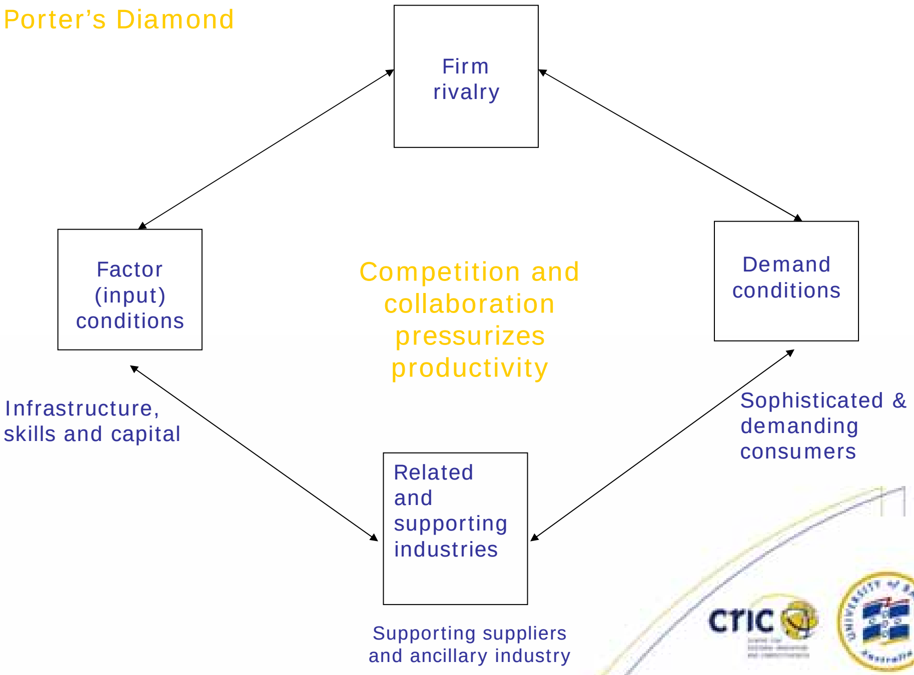
clustering and place

- An economic geographer's perspective:
  - Based on spatial agglomeration of economic activity and the growing salience of the region in the global economy;
  - Provides a 'brand' identity(Martin & Sunley, 2002).

clustering, industry and place

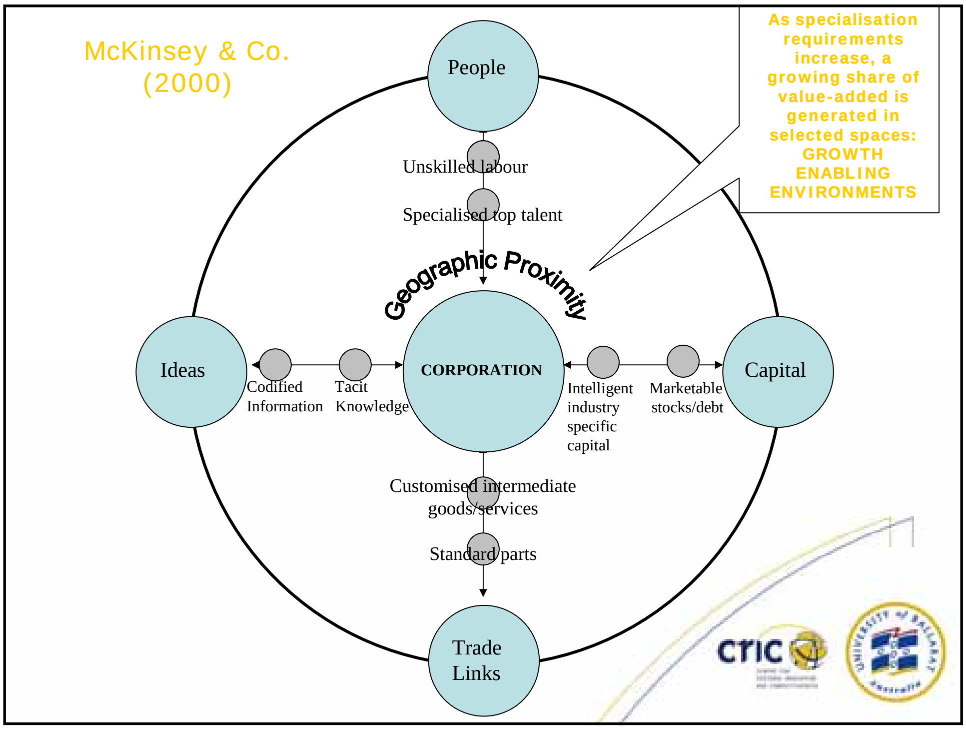
- Porter's (1998)perspective
  - Industry specific and place specific;
  - dynamic effects created by interaction of industry and place;
  - Competition and consumer savvy leads to pressure on productivity ⟶ innovation, both location and place potentially important;
  - Model has been influential in the operational aspects of (mature) clusters, it is weak in terms of SME clustering processes.

Porter's Diamond



clustering, industry and place

- McKinsey's perspective
  - Partly determined by industry - intelligent capital intensifies with geographic proximity;
  - Industry type influences knowledge dynamics through the impact on intelligent capital, specialised labour, 'industry' knowledge and customised product.



clustering, industry and place

- Social infrastructure perspectives:
  - Clustering activities are distinguished by the intensity of social infrastructure and firm interaction (Rosenfeld 2001);
  - Clustering is partly determined by knowledge diffusion, which relies on two critical factors: (1) geography & (2) social infrastructure (Enright and Roberts 2001);
  - Industry networks play a key role as knowledge is embedded within industry (McRae-Williams et al, 2005).

why do SMEs cluster?

- Clustering simulates large firm behaviour, since small firms are not in a position to internalise externalities through economies of scale;
- SMEs cluster to access resources, to reduce costs, to compete with larger firms, and to innovate;
- By networking and sharing knowledge, SMEs are able to compete for and access specialised resources and information systems as well as internalise competencies and assets (Tayler & McRae-Williams, 2005)

networks vs. clusters

- When knowledge is broadened and new entrants are attracted, clustering dynamics change;
- The knowledge diffusion process is both place and industry dependent;
- Differences between narrow based knowledge clusters and broad-based knowledge clusters;
- Clusters and networks are interdependent constructs each with its own characteristics;
- Small business network structures underpin the growth and sustainability of clustering.

Networks	Clusters
Networks allow firms access to specialised services at lower costs	Clusters attract needed specialised services to a region
Networks have restricted membership	Clusters have open membership
Networks are based on contractual agreement	Clusters are based on social values that foster trust and encourage reciprocity
Networks make it easier for firms to make complex products	Clusters generate demand for other firms with a variety of similar and related capacities
Networks are based on cooperation	Clusters take both cooperation and competition
Networks have common business goals	Clusters have collective visions

Clusters versus Network Characteristics
Adapted from Rosenfeld (2001)

examples of SME clustering

- 'Third Italy' clustering (Asheim, 2001) dominated by the specific history and culture of northern Italy, suggests a dominance of region rather than industry → experience that may not be easily transferable (McRae-Williams et al., 2005);
- In Indonesia SME clustering remains in its infancy, despite policy support to foster SME clustering. Indonesian SME clustering is dominated by latent clustering characteristics, typified by stagnation, insufficient critical mass, a low degree of actor interaction and a lack of access to external networks and markets (Tambunan, 2005).

examples of SME clustering

- Successful cross-border SME clustering in Singapore and Malaysia. SMEs compete in an innovative milieu, where information sharing and learning is taking place based on prior existence of trust and in an atmosphere of continued trust building between stakeholders (Konstadakopulos, 2000);

- SMEs have access to national and international innovation networks which are providing these regional SMEs with the resources to become global players.

Australian SME clustering

– Federal Government support for industry clustering;

– Philosophical debate whether clustering should be government- or industry-led varies from Australian state to state;

– Approx. 70 regional small business cluster initiatives identified, but Australian clusters have insufficient focus and still lack critical mass (Brown 2000);

– Still initial scepticism and lack of trust among industries and firms (Martinez-Fernandez, 1999);

– The limited Australian cluster literature concurs that small firms do not have a natural propensity towards collaboration (Braun 2002).

Australian SME clustering

- Birchip Cropping Group, a farmer driven agricultural research cluster in western Victoria: value is created through social cohesion, the exchange of information, farmer learning (Lowe & Berrisford, 2002);
- Various tourism clusters (e.g.,Daylesford Victoria and the Great Barrier Reef) demonstrates that the tourism industry has the potential to achieve positive economic outcomes through clustering (Roberts, 2000);
- Conversely, a recently completed cluster complementarity study on co-located regional wine and tourism clusters suggests that cluster overlap does not necessarily influence the capacity of clusters or turn them from passive into active clusters (McRae-Williams et al., 2005).

regional innovation

- Regional innovation and related economic power revolves around:
  - Local-global relationships/networks and regional milieux (Castells, 2000, Doloreux, 2004; Enright and Roberts, 2001; Storper 1997)
  - Networking, knowledge exchange and enabling SME learning environments (Nonaka & Takeuchi, 1998)
  - Social capital and Trust (Putnam, 2000; Fukuyama, 1994; Granovetter 1973)
  - Learning communities (Morgan 2001; Maskell & Malmberg (1999)
  - Organisational processes, activities, capabilities & efficiencies (Marceau & Dodgson, 1998)
  - Knowledge Creation and Knowledge transfer (Braun 2004)

SME knowledge exchange

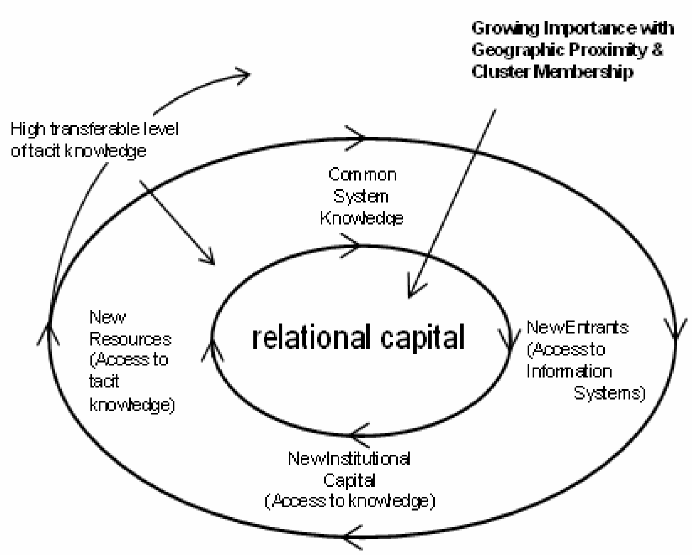
- Regional conditions have great bearing on the clustering process;
- Clustering is conditional on network member interaction;
- SME innovation networks are sustained through highly localised knowledge exchange and networking processes (Doloreux, 2004; Maskell & Malmberg, 1999);
- High levels of networking and trust create embeddedness, strong ties and dependable behaviour (Granovetter, 1985);
- Trust creates open exchange of knowledge and ideas across the cluster domain, which fosters high levels of localised collective learning, competitive advantage and innovation (Capello,1999; Keeble & Wilkinson, 2000).

relational capital issues

- Large firms are able to access specialised knowledge because they are able to internalise knowledge;
- SMEs are limited by their access to specialised knowledge;
- SMEs compete with larger firms by accessing specialised knowledge through clustering;
- What types of relational knowledge are generated at what stages of the SME clustering process?

relational capital propositions

- SME knowledge exchange is a cyclical process, with different types of knowledge being exchanged at different points of cluster maturity;
- Knowledge becomes more important with geographic proximity and cluster membership, whereby a distinction is made between:
  - gaining access to data captured in an open or common system
  - gaining access to data captured in an information system; data which is part of institutional knowledge;
  - accessing tacit knowledge.



Three Australian examples

Regional SME tourism network study

- Both place and industry had an impact on SME knowledge exchange;
- Tourism SMEs felt disconnected from the domain; displayed a low level of interfirm trust; and showed little interest in clustering;
- This resulted in latent clustering behaviour, whereby some data and information was traded, but no tacit knowledge was exchanged;
- Without exogenous pressure on endogenous network relationships, regional industry actors shaped their individual futures in isolation (Braun, 2004).

Three Australian examples

Regional grains industry clustering study

- Conducted in a geographic location near the tourism clustering study.
- In assessing the extent and infrastructure of the grains industry in the region, the study found that regional agricultural actors maintained close communication ties, displayed a high level of trust, and were committed to exchanging tacit knowledge for cluster growth purposes
- Value was created for both the performance of the cluster and for the end user of the product (Lowe & Berisford, 2002).

Three Australian examples

Study on the interaction or complementarity between two co-located regional industries — wine and tourism

- Industries share common attributes such as geographic co-location and economic, social and natural resource assets
- Significant demand and supply side complementarities that create better conditions for the development and performance of both industries
- Wine clustering actors were inclined to exchange knowledge with each other and with the tourism industry, but the reverse was not the case (McRae-Williams, 2005).

Three Australian examples

Implications:

- Raises important questions about the role of industry and place on clustering and knowledge transfer activities;
- relational capital results in either strong or weak regional ties with implicit clustering implications;
- Relational resources can be purposely used to encourage and enhance regional clustering success;
- SME understanding of the possible implications of operating in isolation vs. through place and industry in terms of long-term impact on the region's global visibility and strategic opportunities.

further implications

- SME behaviour impacts on knowledge creation and knowledge transfer, which in turn has implications for both industry as well as place;
- Clustering behaviour is determined directly by industry, place and SME behaviour;
- SME knowledge creation is determined directly by industry and by the personal characteristics of actors;
- Simultaneity between SME behaviour and clustering processes;
- Industry type has an impact on clustering processes and knowledge flow.

clustering & SME behaviour

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Place, Industry ------------------------→ Clustering
                                            Behaviour
                                               ^
                                             |  |
                                             |  |
                                               V
Industry -------------------------------→  SME
                                          Behaviour
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Tourism Industry	Wine Industry
Broad knowledge base	Narrow knowledge base
Low entry barriers	Professional entry requirements
Low/non-specialised skill base	Highly specialised skill base
Weak network ties/weak social structure	Strong network ties/strong social structure
Low level of collaboration (data sharing)	High level of collaboration (tacit knowledge sharing)
Low level of clustering	High(er) level of clustering

Industry Characteristics

Policy Implications

– If place and industry do play differential roles, clustering initiatives should allow for place and industry differentiation;

– Since clusters are critical for SMEs in terms of access to resources and knowledge, general policies directed towards SMEs should always include clustering aspects;

– Clustering initiatives would do well to provide enabling constructs for SME learning;

– Adopt new economy evaluation metrics for regional development policies and associated learning practices.

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Small Business Clustering:
The Benefits of Local Network Learning

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Abstract

Over the last decade there has been considerable interest and activity in clustering and the concomitant link to regional development. In the world economy small and medium enterprises (SMEs) are now recognised as playing a pivotal role in regional economic sustainability and growth, yet there is relatively little research that examines SME clustering processes, and in particular the nature of knowledge creation in local/regional SME networks. This paper discusses the topic of small business clustering and local network knowledge transfer. It outlines some of the key literature on clustering within a regional development context and discusses the implications on industry and place vis-à-vis regional cluster learning, knowledge creation and innovation. To illustrate SME clustering and knowledge transfer issues, the paper briefly highlights three regional Australian small business clustering studies. The paper concludes with some future directions for SME clustering in terms of policy, industry and place.

Introduction

Over the last decade there has been considerable interest and activity in clustering and the concomitant link to regional development. It is widely accepted that technological change underpins a global economy and that geographic location and concentration is of foremost importance for regional development and competitive advantage (Porter, 2000). In the context of emerging technologies and related knowledge-economy business models, linking stakeholders in dynamic clusters is believed to enhance competition and regional innovation (OECD, 1999). The literature is saturated with views on geographic proximity, or clustering of industries, companies and institutions (Asheim, 2001; Brusco, 1990; Krugman, 1995; Porter, 1990).

The geographic scope of clusters can vary from a single city, state or region to a network of companies across state borders or even country borders. There are various clustering forms that may ensue to optimise competitive advantage. Clustering can be formal or informal, in the public or private sector; horizontal or vertical; physical; and even sometimes virtual. In horizontal clustering companies within the same industry sector are co-located in a particular geographic area and might share an industrial or technological base, operate within a common market and a use a common purchasing and/or distribution channel (Michael, 2001).

Vertical networks include horizontal cluster participants as well as supply chain members such as suppliers, consumers and related services (Boekholt, 1997). Diagonal clustering refers to the concentration of complementary or symbiotic activities, whereby each firm adds value to the other. There are of course many other cluster dimensions that could be examined, e.g., density elements, breadth and depth of a cluster, industry activities, cluster governance, to name but a few, which fall outside the discussion scope of this paper.

As industry clusters become more accepted, their definition, boundaries and composition become more complex, which has led some cluster researchers, e.g., Rosenfeld (1997, 2001, 2003), to focus on clustering activities rather than on clusters as such. This paper focuses on regional SME clustering activities with an emphasis on regional relationships and local network learning. The cluster definition adopted for this paper is a geographic co-location of activities that are linked horizontally, vertically or diagonally along the value chain. This co-location serves as an attractant to new companies wishing to access intelligent services and goods (McKinsey and Co, 2000) and facilitates knowledge transfer, either formally or through spillovers. Learning and knowledge creation among cluster participants can improve cluster efficiency and effectiveness, and may act as a spur to innovation. As the cluster gains an identity it becomes an attractant to new entrants, e.g., suppliers, buyers and institutions, and creates major external economies for cluster participants. With the exception of virtual clustering, where geographic proximity is not necessarily applicable, much of the cluster literature emphasizes the importance of local networks and local/regional relationships for competitive advantage (McRae-Williams, Lowe, & Taylor, 2005).

Porter (1990) discusses competitive advantage as being “created and sustained through a highly localized process" (p.19) and ascribes enduring competitive advantage in a global economy to local knowledge, relationships and motivation that cannot be duplicated by global partnering (Porter, 1998). Critical to Porter’s analysis of clusters are the dynamic effects created by interaction of industry and place (Porter, 2003). His theory on successful local cluster development in a global economy depends on four main factors: (1) context for firm strategy and rivalry inside the cluster, e.g., competition and collaboration put pressure on productivity; (2) demand conditions, e.g., level of sophistication and demand of consumers; (3) related and supporting industries, e.g., the supporting suppliers and ancillary industry; and (4) factor conditions, e.g., availability of infrastructure, skills and capital (Porter, 2000). Factor conditions support the development of the cluster. Thus, in Porter’s model the interaction between these factors or the competition and consumer pressure leads to pressure on productivity and hence to innovation, in which both location and place are potentially important. Although Porter’s model has been influential in the operational aspects of (mature) clusters, it is weak in terms of SME clustering processes.

Clustering is partly determined by industry. McKinsey and Co (2000) suggest that intelligent capital intensifies with geographic proximity. Industry type influences knowledge dynamics through the impact on intelligent capital, specialised labour, 'industry' knowledge and customised product. Whilst both industry and geography are necessary elements, neither is sufficient on its own; one factor might dominate or, each factor might operate effectively only in the presence of the other (McRae-Williams, 2005). In this paper it is suggested that industry plays a key role as knowledge is embedded within industry.

Clustering is also partly determined by knowledge diffusion, which relies on two critical factors: (1) geographic proximity and (2) social structure (Enright & Roberts, 2001). Rosenfeld (1997) distinguishes clustering activities by the intensity of social infrastructure and firm interaction, firmly placing social capital and trust as the basis of collaboration, information and knowledge flows in regional clusters. Swann, Prevezer & Stout (1998) similarly position relational capital at the core of cluster strength and as the foundation of its knowledge base. Porter actually suggests that there is a gap in the cluster literature around social structures (Porter, 1998), which may be more important for SMEs than the existence of a mature cluster. This paper hence focuses on social structures and knowledge transfer in a clustering context.

So why do small firms cluster? As scholars such as Keeble & Wilkinson (2000), Storper (1997) and others point out, transaction cost savings alone is insufficient to explain the growth and persistence of clusters. One explanation is that large firms internalise much of the lateral, horizontal and vertical scope of a cluster. They are able to do so because they have economies of scale. SMEs are limited in their access to specialised resources and intelligent capital. Taylor and McRae-Williams (2005) posit that clustering simulates large firm behaviour, e.g., when small firms are not in a position to internalise externalities through economies of scale, they cluster to access resources, to reduce costs, to compete with larger firms, and to innovate. In other words, by networking and sharing knowledge, small firms are able to compete for and access specialised resources and information systems as well as internalise competencies and assets that typically are internalised by large firms with economies of scale (Tayler & McRae-Williams, 2005). Clustering hence provides SMEs benefits that would be unavailable or be available at a greater cost to non-clustering members. While value-added and activities such as R&D, access to a global client base and advanced business services/production are clearly major contributing factors for small business clustering, the need for access to localised explicit and tacit knowledge networks has proven to be a central driver for clustering (Keeble, 2000).

Regional Clustering and Local Networks

The growing influence of information and communication technologies (ICT) as the critical factor in shaping modernity and the distribution of economic advantage is relevant to regional development as it directly impacts on interactions between local and global forces. Giddens (1990) conceives globalisation as the stretching process between local involvement and interaction across distance, whereby the “local transformation is as much part of globalisation as the lateral extension of social connections across time and space” (p.64). Applying his so-called ‘glocalisation’ framework, Robertson (1995) places spatial issues on an equal footing with temporal ones by examining local and global forces in a concrete locality. In Castells’ (2000) notion of a ‘regionalized, global economy’ government intervention, regional (government) structures and networks play a significant role in the positioning of a region in the global economy (p102). Networking and the collaborative nature of the global economy reinforce tendencies towards geographical clustering because of the advantages to be gained from proximity to other firms in specialist and related industries (Enright & Roberts, 2001; Storper, 1997).

For SMEs, local networks represent a complementary response to insecurity arising from development and use of new technologies. The drive for SMEs to collaborate reduces uncertainties in the global economy and is a means of supplementing and complementing limited resources (Doloreux, 2004). Contrasting globalisation and localisation, Enright and Roberts (2001) conclude that in the new economy clusters are regionally driven with local communities seeking to maintain their social, environmental and economic agendas in a global economic climate. There is increasing evidence that the performance of existing enterprises is significantly improved by clustering (Rosenfeld, 2003, 2001).

Typically, firms and individual actors are embedded in a variety of formal and informal professional, social and intellectual exchange networks (Granovetter, 1973). The extent and importance of these networks usually relate to firms’ and actors’ horizontal and vertical relationships, network culture and strategic complementarity. The knowledge and social capital a person accumulates through networking is highly personal, tacit knowledge, and considered a valuable asset (Nonaka & Takeuchi, 1995). In terms of social capital transaction, external network relations accentuate ‘bridging’ forms of social capital, whereas internal network ties focus on ‘bonding’ forms of social capital (Putnam, 2000). Providing a comprehensive review of social capital literature across a variety of disciplines, Adler and Kwon (2002) list trust; reciprocity; social norms and obligations; participation in relationships; and pro-activity among the elements contained in social capital. Freeman (1991) similarly refers to factors such as trust, ethics and confidence in the cooperativeness of others for effective networking. It is not unusual for SMEs to fear opportunistic behaviour from competitors and scholars commonly stress the importance of trust and personal interaction in interfirm alliances (Gulati, 1995; Ring & Van de Ven, 1992). The trust may be historical and already exists between individuals of different firms or, conversely, may need to be fostered.

Trust and social capital are attributes not only of industry networks but also of entire geographic regions, which can help expedite economic development and facilitate large-scale economic activities (Fukuyama, 1995). Trust and reciprocity within clustering domains very much depends on the individuals within the network. When knowledge is broadened and new entrants are attracted, clustering dynamics change. The knowledge diffusion process is both place and industry dependent (Braun, 2004) and differences can observed between narrow based knowledge clusters and broad-based knowledge clusters.

Thus, it may be argued that clusters and networks are different yet interdependent, whereby small business network structures underpin the growth and sustainability of clustering. Clusters and networks should hence be seen as two separate constructs, each with its own distinctive characteristics (Figure 1).

Networks	**Clusters**
Networks allow firms access to specialised services at lower costs	Clusters attract needed specialised services to a region
Networks have restricted membership	Clusters have open membership
Networks are based on contractual agreement	Clusters are based on social values that foster trust and encourage reciprocity
Networks make it easier for firms to make complex products	Clusters generate demand for other firms with a variety of similar and related capacities
Networks are based on cooperation	Clusters take both cooperation and competition
Networks have common business goals	Clusters have collective visions

Figure 1
Clusters versus Network Characteristics
Adapted from Rosenfeld (2001)

High levels of networking and trust create embeddedness, strong ties and dependable behaviour (Granovetter, 1985), enabling open exchange of knowledge and ideas across the cluster domain, which in turn fosters high levels of localised collective learning, competitive advantage and innovation (Capello, 1999; Keeble & Wilkinson, 2000).

SME Clustering

Inspired by the prosperity of regions such as the 'Third Italy', which is characterised by strong local SME clustering and economic interdependencies, policy makers in different parts of the world have been seeking to duplicate successful SME clustering experiences to unlock the wealth of their own regions (Asheim, 2001). This is not to say that the Italian experience can easily be emulated. In Italy, cluster development has been dominated by the specific history and culture of northern Italy. This suggests a dominance of region rather than industry, an experience that may not be easily transferable to the rest of the world (McRae-Williams et al., 2005).

The SME clustering literature indicates that regional conditions have great bearing on the clustering process; that clustering is conditional on network member interaction; and that SME innovation networks are sustained through highly localised knowledge exchange and networking processes (Doloreux, 2004; Maskell & Malmberg, 1999).

In Indonesia, for example, SME clustering remains in its infancy, despite policy support to foster SME clustering. Indonesian SME clustering is dominated by latent clustering characteristics, typified by stagnation, insufficient critical mass, a low degree of actor interaction and a lack of access to external networks and markets (Tambunan, 2005). Conversely, Konstadakopulos (2000) provides empirical evidence of successful cross-border SME clustering in Singapore and Malaysia. Since aforementioned SMEs not only collaborate but also compete in an innovative milieu, Konstadakopulos (2000) deducts that information sharing and learning is taking place based on prior existence of trust and in an atmosphere of continued trust building between stakeholders. The latter author also points to national and international innovation networks which are providing these regional SMEs with the resources to become global players.

In Australia, the Federal Government has also shown renewed interest in, and support for, industry clustering, although the philosophical debate whether clustering should be government- or industry-led varies from Australian state to state. The state of Victoria, for example, has opted for an industry-based cluster policy that focuses on attracting major national and foreign companies into the State (Enright & Roberts, 2001). Having identified some seventy regional small business cluster initiatives, Brown (2000) believes that Australian clusters have insufficient focus and still lack critical mass. A cluster development and cross-industry collaboration study in the state of New South Wales revealed much initial scepticism and lack of trust among industries and firms (Martinez-Fernandez, 1999). The limited Australian cluster literature concurs that small firms do not have a natural propensity towards collaboration.

There are, nonetheless, some recent reports on successful Australian collaboration in the agricultural sector (Insights, June 2002). In the Birchip Cropping Group, a farmer driven agricultural research cluster in western Victoria, value is created through social cohesion, the exchange of information, farmer learning and, perhaps above all, a shared vision, drive and passion (Lowe & Berrisford, 2002). Other positive cluster accounts come from the tourism industry. Natural resources have long provided small tourism firms with a clustering incentive around geographic icons such as a natural health spa or a national park. Natural assets in Far North Queensland, home of The Great Barrier Reef, have driven the Queensland tourism industry to concentrate on certain locations, demonstrating that the tourism industry has the potential to achieve positive economic outcomes through clustering (Roberts, 2000). On the virtual tourism cluster front, a collaborative e-commerce gateway was successfully adopted as an additional destination sales channel and supply chain booking service in Daylesford, Victoria (Multimedia Victoria, 2002). Conversely, a recently completed cluster complementarity study on co-located regional wine and tourism clusters suggests that cluster overlap does not necessarily influence the capacity of clusters or turn them from passive into active clusters (McRae-Williams et al., 2005).

European politicians have addressed the tension between competitiveness and cohesion within regions by using novel trans-sectoral and proactive approaches to create bridges between small firms, and between institutions and industry (The European Spatial Development Perspective, 1999). Recognising that economic growth is accomplished by designing regional-level intervention -- that allows actors within regions to shape their own development prospects and stimulate learning -- European spatial policy initiatives specifically include the building of epistemic or learning communities based on embedded competencies and social structures (Henderson & Morgan, 2001; Maskell & Malmberg, 1999).

Learning and Knowledge Creation

In today's global economy, knowledge is considered a precious commodity and concepts like knowledge sharing and lifelong learning have become increasingly prevalent in business practices (Senge & Scharmer, 2001). In this new environment, the nexus of sustainable economic development rests upon the ability of partners to learn, create and harness knowledge collaboratively and continuously (Florida, 1995). In the transition to a learning-based economy, the 'new regionalism' focuses on social and institutional learning as the prime driving forces behind regional economic growth (MacKinnon, Cumbers, & Chapman, 2002).

The concept of collective learning lies at the base of the innovative and creative milieu theory, whereby the presence of common knowledge goes beyond the individual firm yet remains within the boundaries of the milieu or, as the case may be, cluster domain (Cumbers, Mackinnon, & Chapman, 2002). Collective learning is generally defined in the literature as "a social process of knowledge accumulation" (Capello, 1999, p.720-721), whereby knowledge creation through interaction and continuity provides an important vehicle for the transfer of knowledge over time. Through collective learning, regional clusters can reduce uncertainty, foster innovative milieux, and augment creative capacity for firms by way of information and knowledge diffusion throughout the local network (Amin, 1999; Marceau & Dodgson, 1998; Storper, 1997). By formulating networks in which socially a variety of regional agents and institutions take part in interactive learning processes, it is believed that regions can create competitive advantage (Amin & Thrift, 1995; Lundvall & Johnson, 1994; Morgan, 1997).

Turning ourselves into collective communities of learning is, however, not an easy task (Brown & Duguid, 2000). Collective learning and knowledge creation are spiralling processes of interaction fusing explicit and tacit knowledge (Nonaka & Konno, 1998). Interaction creates new knowledge when actors bring their knowledge to a shared space, referred to by Nonaka and Konno (1998) refer to as ba. This space can be physical, mental, virtual, or a combination thereof. The socialisation, externalisation, combination and internalisation (SECI) cycle, which represent the four characteristics of ba space as described in the SECI model, provide the knowledge creation platform. Regardless of the environment, "to participate in ba means to get involved and transcend one's own limited perspective or boundary" (p.47). Von Krogh, Ichijo, & Nonaka (2000) emphasise the need for an enabling context for learning and knowledge sharing, based on the ba concept, where participants set and change their own boundaries of learning. In considering regionally embedded network conditions, suitable local learning constructs can be designed (Braun & Billard, 2002).

Apart from enabling learning constructs, there are relational capital issues to consider and questions that arise, e.g., what types of relational knowledge are generated at what stage of the SME clustering process? Large firms are able to access specialised knowledge because they are large enough to internalise knowledge. SMEs, to the contrary, are limited by their access to specialised knowledge. They can, however, compete with larger firms by accessing specialised knowledge through clustering. Based on the Swann et al (1998) virtuous clustering model, which positions relational capital at the core of cluster strength, the authors propose that SME knowledge exchange is a cyclical process, with different types of knowledge being exchanged at different points of cluster maturity. In other words, a certain amount of codified data and information has been captured by the system, which is augmented by new entrants, which leads to increased institutional knowledge, which in turn creates more tacit knowledge and attracts new resources (and entrants). The model cycles upward (indicating growth) as the steps are repeated (Figure 2).

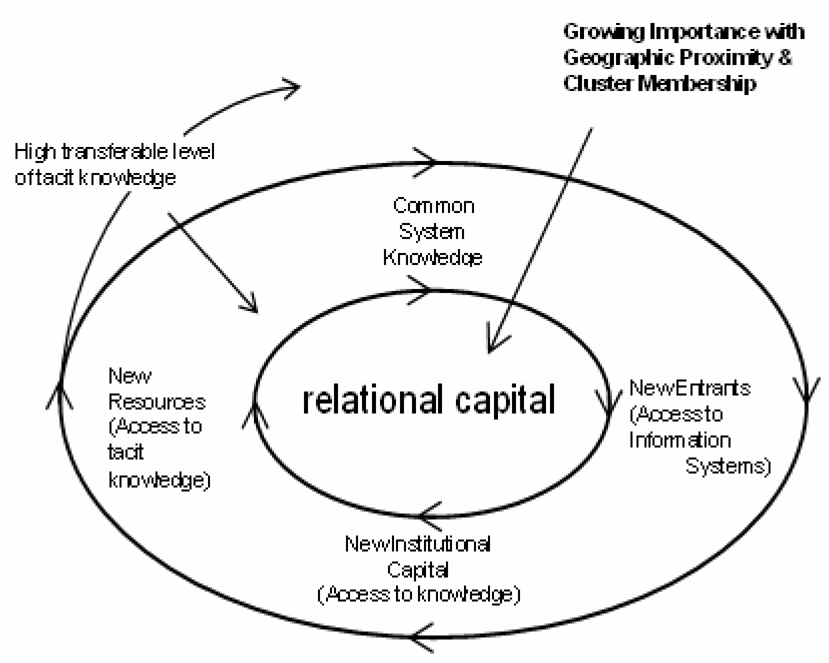

Figure 2
Relational Capital Cycle

Knowledge becomes more important with geographic proximity and cluster membership, whereby a distinction is made between gaining access to data captured in an open or common system vs. gaining access to data captured in an information system; vs. data which is part of institutional knowledge; vs. accessing tacit knowledge. Data captured in a common system is accessible by and to all (e.g., using a search engine on the Internet). To access and understand data captured within a specific information system (e.g., in an industry context), geographic proximity is desirable, if not necessary. Knowledge can, for example, might be obtained through industry association membership. Institutional capital is highly location and boundary specific (you have to be there to be ‘in the know’), while tacit knowledge is embedded within the local system, industry or community. To access tacit knowledge proximity is required, e.g., the reason why SME clustering membership is important.

Three regional Australian clustering studies provide some initial insights into these relational capital propositions. In a regional small business tourism network study, both place and industry had an impact on SME knowledge exchange. In this study, tourism SMEs felt disconnected from the domain, displayed a low level of interfirm trust, and showed little interest in clustering. This resulted in latent clustering behaviour, whereby some data and information was traded, but no tacit knowledge was exchanged. Without exogenous pressure on endogenous network relationships, regional industry actors shaped their individual futures in isolation (Braun, 2004).

The latter study result is in sharp contrast with a clustering study in the grains industry conducted in a geographic location near the tourism cluster. In assessing the extent and infrastructure of the grains industry in the region, the study found that regional agricultural actors maintained close communication ties, displayed a high level of trust, and were committed to exchanging tacit knowledge for cluster growth purposes. As a result, value was created for both the performance of the cluster and for the end user of the product (Lowe & Berrisford, 2002).

In the third study the level of interaction or complementarity between two co-located regional industries in Western Victoria — wine and tourism — was assessed. The wine and tourism industries within this region share a number of common attributes such as geographic co-location and economic, social and natural resource assets. In some cases the industries compete for land, capital and skilled labour. However, they also have significant demand and supply side complementarities that create better conditions for the development and performance of both industries. In this study it was evident that wine clustering actors were inclined to exchange knowledge with each other and with the tourism industry, but the reverse was not the case. This research confirms tourism industry findings of the aforementioned tourism study, raising important questions about the role of industry and place on clustering and knowledge transfer activities (McRae-Williams, 2005).

In the three case studies, relational capital resulted in either strong or weak regional ties with implicit clustering implications. All cases show that relational resources can be purposely used to encourage and enhance regional clustering success. These case studies also raise questions about SME understanding of the possible implications of operating in isolation versus through place and industry in terms of long-term impact on the region's global visibility and strategic opportunities.

Future Directions

Apart from discussing the need to provide enabling constructs for SME learning, the authors have raised questions surrounding relational capital and introduced a cyclical model to indicate what type of relational knowledge is generated at what stage of the SME clustering process. Based on the Swann et al (1998) virtuous clustering model, which positions relational capital at the core of cluster strength, the authors propose that SMEs exchange different types of knowledge — ranging from data, to information, to knowledge, to tacit knowledge — and that these types of knowledge interactions occur at specific points in the clustering process.

The paper briefly highlighted three regional Australian small business clustering studies, raising questions about SME understanding of the possible implications of operating in isolation versus through place and industry in terms of global visibility and strategic opportunities.

What are the implications for cluster development and new venture creation in different industries and different places? US data suggests that there are dominant locations and that some industries, particularly science based industries are over-represented (Institute for Strategy and Competitiveness, 2004). Whilst the impact of place and industry are examined in some detail in these studies, SME relationships to clustering, place and industry are not specified. Other data emanates from the classic industrial districts of Italy (Harrison, 1991) and suggests a dominance of region rather than industry, an experience that may not be easily transferable to the rest of the world (McRae-Williams et al., 2005). Our research suggests that SME behaviour impacts on knowledge creation and knowledge transfer, which in turn has implications for both industry as well as place. The relationships may be illustrated thus:

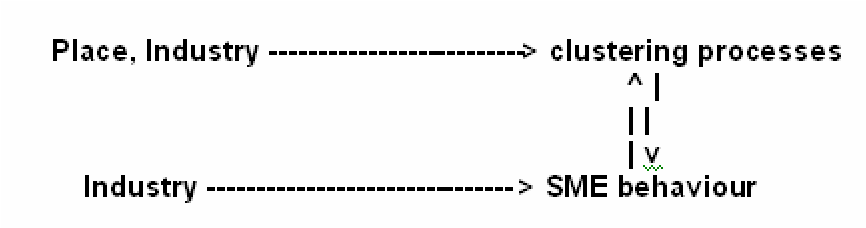

Figure 3
Clustering and SME behaviour

In the above model, clustering behaviour is determined directly by industry, place and SME behaviour. Conversely, SME knowledge creation is determined directly by industry and by the personal characteristics of actors. Thus, if place and industry affect clustering processes, and if industry affects SME clustering behaviour and knowledge exchange, arguably there is always a degree of interdependence (simultaneity) between SME behaviour and clustering processes. From our regional clustering studies we have been able to deduct that industry type has an impact on clustering processes and knowledge flows, as illustrated below in Figure 4.

Tourism Industry	**Wine Industry**
Broad knowledge base	Narrow knowledge base
Low entry barriers	Professional entry requirements
Low/non-specialised skill base	Highly specialised skill base
Weak network ties/weak social structure	Strong network ties/strong social structure
Low level of collaboration (data sharing)	High level of collaboration (tacit knowledge sharing)
Low level of clustering	High(er) level of clustering

Figure 4
Industry Characteristics

What are the implications for cluster policy in different industries and different places? This paper has shown that some places and some industries cluster better than others. Clustering policies often overlooks this important fact. If place and industry do play differential roles, clustering policies should allow for place and industry differentiation. Furthermore, since clusters are critical for SMEs in terms of access to resources and knowledge, general policies directed towards SMEs should always include clustering aspects. While such policies cannot capture tacit knowledge or compel network actors to exchange knowledge, they can enhance clustering processes and help to capture knowledge through the fostering of institutional capital. The Australian Government, for example, is establishing so-called technical colleges which will have curricula that are responsive to local needs (Department of Education Science and Training, 2005). These types of institutions are well placed to capture and disseminate industry knowledge.

Despite this popularly adopted regional development agenda by academics and international policy makers (APEC, 2001; OECD, 1999), there are limitations to consider vis-à-vis the dependency on learning for regional innovation (MacKinnon et al., 2002). Although regional learning is presumably anchored in endogenous capacities — that is, the social and institutional relationships within a region — we cannot disregard innovation and knowledge creation via exogenous or extra-local influences such as extra regional and global Internet networks {MacKinnon et al., 2002}. Besides, as Freeman (1994) has pointed out, those (nations) that are adept at matching institutional innovation with the emerging techno-economic paradigm are likely to forge ahead; those that suffer from institutional 'drag' or inertia may fall behind (Freeman, 1994). Focusing on the dynamic nature of the new economy, Maskell and Malmberg (1999) similarly point out that the capacity to learn and adapt to change defines the success of a region. However, it may be said that in our connected society there is unprecedented emphasis on learning and the creation, distribution and exchange of information and knowledge (Asheim, 2001) (P Maskell & Malmberg, 1999).

Even more difficult perhaps is how to measure the often-intangible outcomes of collaboration and learning for regional development purposes, e.g., the innovative behaviour of SMEs and regional clusters. Still in its infancy with little practical evidence available as to its merit (Maskell, 1997), evaluation models associated with regional clustering policies continue to be based on traditional quantitative statistical and econometric analysis methods. New evaluation metrics for regional development policies and associated learning practices would do well to move away from traditional economic impact or monetary cost-benefit analyses towards interactive and participatory regional evaluation processes (Diez, 2001). Formative and summative evaluation processes might include demand-side trust, perceived value added and other intangibles such as social capital, absorptive capacity and traded knowledge (Henderson & Morgan, 2001).

In considering the critical factors of regional clustering (communication and a collaborative culture) in the context of geographic concentration and learning, it is essential to recognise the need for learning constructs and support to build network capacity to learn and change. In North America, the formation of interfirm learning networks is closely linked to Mode 2 learning (Gibbons et al, 1994). Network development academics and practitioners often use action-oriented methodologies, such as action learning, action research and future search methods, as they support reflexive learning processes and promote change (Chisholm, 1998). In Scandinavia, action research is consistently used to optimise regional learning and network organisation (Gustavsen, 1998; Hanssen-Bauer, 1998). In University-led SME learning networks in Sweden, action research methods have successfully assisted small companies to form closer relationships and beneficial learning partnerships. Positive outcomes ensue when SME learning styles and needs were met; trust between firms was built; and committed interest in the learning network was present (Tell, 2001). In building knowledge creation networks, it is also essential to consider the role of technology itself. Computer-based collaborative learning environments now form an integral part of the larger context of economic collaboration and hence merit further attention to optimise the values and principles of regional SME clustering and collaborative learning.

References

Adler, P., & Kwon, S. (2002). Social Capital: Prospects for a New Concept. Academy of Management Review, 27(1), 17-41.

Amin, A. (1999). An institutionalist perspective on regional economic development. International Journal of Urban & Regional Research, 23(2), 365-379.

Amin, A., & Thrift, N. (1995). Globalization, Institutions and Regional Development in Europe. Oxford: Oxford University Press.

APEC. (2001). Beijing Initative on APEC Human Capacity Building. Retrieved 10 July, 2001, from http://www.apec.org

Asheim, B. (2001). Learning regions as development coalitions. Partnership as governance in European workforce states? Concepts and Transformation, 6(1), 73-101.

Boekholt, P. (1997). Innovative Networks in Regional Economies: Enhancing Infrastructures for Technology Creation and Transfer. In J. Mitra & P. Formica (Eds.), Innovation and Economic Development, University-Enterprise Partnerships in Action (pp. 119-137). Dublin: Oak Tree Press.

Braun, P. (2004). Regional Innovation and Tourism Networks: the nexus between ICT diffusion and change in Australia. Information Technology & Tourism, 6(4).

Braun, P., & Billard, S. (2002). Extending knowledge creation in cyber ba: connectivity, networking and regional development in an Australian context. Paper presented at the Conference on Action research, Constructivism and Democracy, June 5-7, Stockholm.

Brown, J., & Duguid, P. (2000). The Social Life of Information. Boston: Harvard Business School Press.

Brown, R. (2000). Clusters, Innovation and Investment: Building Global Supply Chains in the New Economy. Canberra: Australian Project Developments Pty Ltd, Canberra.
Brusco, S. (1990). The Idea of the Industrial District: Its genesis. In E. Pyke & et al (Eds.), Industrial districts and inter-firm co-operation in Italy (pp. 17-36). Geneva: International Institute for Labour Studies.
Capello, R. (1999). SME Clustering and Factor Productivity: A Milieu Production Function Model. European Planning Studies, 7(6), 719-735.
Castells, M. (2000). The rise of the network society. Oxford: Blackwell.
Chisholm, R. (1998). Developing Network Organizations. Learning from Practice and Theory. Reading, MA: Addison Wesley.
Cumbers, A., Mackinnon, D., & Chapman, K. (2002). Clusters: A Study of SMEs in the Aberdeen Oil Complex. Retrieved 26 February, 2005, from http://www.geog.gla.ac.uk/olpapers/acumbers002.pdf Draft paper published by the Department of Geography & Topographic Science, University of Glasgow
Department of Education Science and Training. (2005). Australian Technical Colleges. A Discussion Paper. Retrieved March 1, 2005, from http://www.dest.gov.au/schools/technicalcolleges/downloads/discussion_paper.pdf
Diez, M. (2001). The Evaluation of Regional Innovation and Cluster Policies: Towards a Participatory Approach. European Planning Studies, 9(907-923).
Doloreux, D. (2004). Regional Networks of Small and Medium Sized Enterprises: Evidence from the Metropolitan Area of Ottawa in Canada. European Planning Studies, 12(2), 173-189.
Enright, M., & Roberts, B. (2001). Regional Clustering in Australia. Australian Journal of Management, 26(Special Issue), 66-84.
Florida, R. (1995). Toward the Learning Region. Futures, 27(5), 527-536.
Freeman, C. (1994). Innovation and Growth. In M. Dodgson & R. Rothwell (Eds.), The Handbook of Industrial Innovation (pp. 81-102). Aldershot: Edward Elgar.
Freeman, C. (1991). Networks of Innovators: A Synthesis of Research Issues. Research Policy, 20, 499-514.
Fukuyama, F. (1995). Trust. New York.: Free Press.
Gibbons, M., Limoges, C., Nowotny, H., Schwartman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge, the dynamics of science and research in contemporary societies*. Guildford: Sage.
Giddens, A. (1990). The Consequences of Modernity. Cambridge: Polity Press.
Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. American Journal of Social Psychology, 62,(989-1002).
Granovetter, M. (1973). The strength of weak ties. American Journal of Sociology, 78, 1360-1380.
Gulati, R. (1995). Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. Academy of Management Journal, 38, 85-112.

Gustavsen, B. (1998). From experiments to network building: trends in the use of research for reconstructing working life. Human Relations, 51(3), 431-438.
Hanssen-Bauer, J. (1998). Networking to Learn in Nordvest Forum: Optimizing the Learning Cycle of a Regional Learning Network Organization through Action Research. In B. Gustavsen, T. Colbjomson & O. Palshaugen (Eds.), Development Coalitions in Working Life: The 'Enterprise Development 2000' Program in Norway (pp. 113-131). Amsterdam: John Benjamins.
Harrison, B. (1991). Industrial districts: old wine in new bottles. Regional Studies, 26(5), 469- 483.
Henderson, D., & Morgan, K. (2001). Regions as Laboratories. The Rise of Regional Experimentalism in Europe. In M. Gertler & D. Wolfe (Eds.), Innovation and Social Learning. London: Palgrave.
Insights. (June 2002). Birchip farmers and CSIRO researchers meet in the paddock and online. Retrieved 7 August, 2002, from http://www.farmscape.tag.csiro.au/newsletter/Edition9/birchip.htm
Institute for Strategy and Competitiveness. (2004). Cluster Mapping Project. Retrieved March 1, 2005, from http://www.isc.hbs.edu/econ-clusters.htm.
Keeble, D., & Wilkinson, F. (2000). High-technology SMEs, regional clustering and collective learning: an overview. In D. Keeble & F. Wilkinson (Eds.), High-technology clusters, networking and collective learning in Europe (pp. 1-20). Aldershot: Ashgate.
Krugman, P. (1995). Development, geography and economic theory. London: MIT Press.
Lowe, J., & Berrisford, N. (2002). Capturing Value in the Grains Value Chain. Ballarat: Centre for Regional Innovation and Competitiveness. University of Ballarat.
Lundvall, B., & Johnson, B. (1994). The Learning Economy. Journal of Industry Studies, 1(2), 23-42.
MacKinnon, D., Cumbers, A., & Chapman, K. (2002). Learning, innovation and regional development: a critical appraisal of recent debates. Progress in Human Geography, 26(3), 293-311.
Marceau, J., & Dodgson, M. (1998). Systems of Innovation. Retrieved 26 October, 2000, from online: http://www.isr.gov.au/industry/summit/reference/learned_group/index.html
Martinez-Fernandez, M. (1999). The Network Perspective in Regional Regeneration: An Organic Analysis of the Hunter Regional Network for Economic Development. Paper presented at the 23rd Conference of the Australia and New Zealand Regional Sciences Association, Newcastle, Australia.
Maskell, P. (1997). Introduction. In P. Eskelinen (Ed.), Regional Specialisation and Local Environment: Learning and Competitiveness. Stockholm: NordREFO.
Maskell, P., & Malmberg, A. (1999). Localised learning and industrial competitiveness. Cambridge Journal of Economics, 23(2), 167-185.
McKinsey and Co. (2000). Report of Regional Rejuvenation in Germany, Berlin.

McRae-Williams, P. (2005). Wine and regional tourism: Cluster complementarity and regional development. Unpublished PhD, University of Ballarat, Ballarat.
McRae-Williams, P., Lowe, J., & Taylor, P. (2005). Economic Clusters, New Venture Creation and Growth. Paper presented at the Regional Frontiers of Entrepreneurship Research, Swinburne University of Technology, February 10-11.
Michael, E. (2001). Tourism Growth and the Development of Micro-Market Clusters. Paper presented at the TTRA 3rd European Conference. Creating and Managing Growth in Travel and Tourism, Börlange, Stockholm, April.
Morgan, K. (1997). The learning region: institutions, innovation and regional renewal. Regional Studies, 31(5), 491-503.
Multimedia Victoria. (2002). Victoria's E-commerce Advantage. E-Commerce Case Studies. Retrieved 19 December, 2002, from http://www.mmv.vic.gov.au/Web/MMV/MMV.nsf/ImageLookup/Ecommerce/$file/20%20supply%20chain2.pdf
Nonaka, I., & Konno, N. (1998). The Concept of "Ba": Building a Foundation for Knowledge Creation. California Management Review, 40(3), 40-54.
Nonaka, I., & Takeuchi, H. (1995). The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. New York: Oxford University Press.
OECD. (1999). Boosting Innovation: The Cluster Approach. Retrieved 20 June, 2000, from http://www.oecd.org
Porter, M. (2003). Clusters and Regional Competitiveness: Recent Learnings. Paper presented at the International Conference on Technology Clusters, Montreal, Canada.
Porter, M. (2000). Location, competition and economic development: Local clusters in a global economy. Economic Development Quarterley.
Porter, M. (1998). Clusters and Competition New Agendas for Companies, Governments, and Institutions. In On Competition (pp. 197-287). Boston, MA: Harvard Business School.
Porter, M. (1990). The Competitive Advantage of Nations. London: MacMillan.
Putnam, R. (2000). Bowling alone: the collapse and revival of American community. New York: Simon and Schuster.
Ring, P., & Van de Ven, A. (1992). Structuring cooperative relationships between organizations. Strategic Management Journal, 13(7), 483-498.
Roberts, B. (2000). Benchmarking the Competitiveness of the Far North Queensland Regional Economy. Brisbane: Queensland University of Technology.
Robertson, R. (1995). Glocalization: Time-Space and Homogeneity and Heterogenity. In M. Feathersone, S. Lasch & R. Robertson (Eds.), Global Modernities (pp. 25-44). London: Sage.
Rosenfeld, S. (2003). Clusters of Creativity: Innovation and Growth in Montana: A Report to the Montana Governor's Office of Economic Opportunity.
Rosenfeld, S. A. (2001). Backing into Clusters: Retrofitting Public Policies. Integrating Pressures: Lessons from Around the World. Paper presented at the John F. Kennedy School Symposium, Harvard University. Regional Technology Strategies, Inc.

Rosenfeld, S. (1997). Bringing Business Clusters into the Mainstream of Economic Development. European Planning Studies, 5(1), 3-23.
Senge, P., & Scharmer, O. (2001). Community Action Research: Learning as a Community of Practitioners, Consultants and Researchers. In P. Reason & H. Bradbury (Eds.), Handbook of Action Research (pp. 238-249). London: Sage.
Storper, M. (1997). The Regional World. London: Guilford Press.
Swann, P., Prevezer, M., & Stout, D. (Eds.). (1998). The Dynamics of Industrial Clustering International Comparisons in Computing and Biotechnology. London: Oxford University Press.
Tambunan, t. (2005). Promoting Small and Medium Enterprises with a Clustering Approach: A Policy Experience from Indonesia. Journal of Small Business Management, 43(2), 138–154.
Tayler, P., & McRae-Williams, P. (2005). Internal versus External Economies of Scale. Working Paper, Centre for Regional Innovation & Competitiveness.
Tell, J. (2001). Organising University-Led Learning Networks Among Small-Enterprise Managers. Göteborg: Chalmers University of Technology. The European Spatial Development Perspective. (1999). Towards Balanced and Sustainable Development of the Territory of the European Union. Retrieved 13 January, 2003, from http://europa.eu.int/comm/environment/forum/spatreport_en.pdf
Von Krogh, G., Ichijo, K., & Nonaka, I. (2000). Enabling Knowledge Creation. Oxford: Oxford University Press.

APEC Best Practice Guidelines on Industrial Clustering for SMEs

(Draft, as of March 9, 2005)

- **Advantages of Industrial Clustering**

The ability to innovate under globalization is the key to the competitiveness of an economy. Industrial clusters are favorable for the establishment of such an ability and enable SMEs to sustain both their development and innovation capabilities. It is well known that there are several advantages for firms, especially SMEs, within an industrial cluster.

First of all, it can provide complementary resources, such as technology and information exchange, management assistance, and so on, to enhance the performance of the firms. Industrial clusters underline the benefits of knowledge sharing, which is the basic reason for firms to congregate together. The information and knowledge shared within a cluster are less related to technology development, and more related to marketing and other factors that affect firm performances.

Secondly, since these firms are located in very close proximity to one another, industrial clusters make regional competition that much keener, thus promoting firms' efficiencies. Fierce competition for both clients and suppliers is unavoidable.

Thirdly, industrial clusters also help firms to quickly respond to the demands of the market or to changes in technologies. Firms within the cluster can fulfill their OEM or ODM contracts much more quickly than those outside of the cluster. The ability to leverage resources to adapt to changes in the markets and to fluctuations in technology should be one of the major benefits for firms to stay within a cluster.

Finally, the adoptions of new information technologies, ICT, do not threaten, but rather enhances cluster viability and vitality. ICT infrastructure alone would not have the same effect. The interaction between cluster dynamics and ICT infrastructure produce the types of benefits. SMEs, located outside a cluster, would not gain as much from the use of the ICT infrastructure even if with a strong reputation. Presence in a branded cluster helps remote clients find SMEs, and trust them to perform the kinds of activities needed.

- **Cluster-based Policies**

Cluster-based policies are useful for regional and national economic development. In an industrial cluster, the government, universities, and firms form a complementary network to facilitate continuous industrial growth, upgrading, and restructuring. An industrial cluster establishes a regional competitive advantage that allows itself to absorb technologies, create new technologies, diffuse knowledge, and retain skilled workers. National endowments create industrial districts, but afterwards the governments should take some policy efforts to transform an industrial district into an industrial cluster. Benefits of industrial clustering apply to both high-tech and traditional industries and there is no reason why SMEs cannot benefit from industrial clustering. However, one must keep in mind that there is no one-size-fits-all industrial-based policy.

1. Infrastructure

It is possible for a government to drive industrial agglomeration through regulatory or policy measures, or through the establishment of industrial parks in the early stage. These strategies may include financial funding to promote incubator best practice, promoting venture capital industry, reducing market-entry barriers by simplifying regulatory and tax schemes, and pursuing international technology cooperation.

Infrastructure items, such as electricity, water, telecommunications, suitable land, living environment and one stop services by the government are all important to pull potential firms and human skills together. For developing countries that lack their own resources to embark on a full-blown infrastructure development, it may be useful for them to concentrate efforts in a small region to attract investments, including foreign capital. After a cluster emerges in the region, then the area can be gradually expanded to include adjacent regions.

2. Sources of Technologies

Geographic location may provide another useful set of boundaries within which to organize innovation. Geography may provide a platform upon which knowledge may be effectively organized. It can be argued that innovation is an important element in the operation of an industrial cluster. Without the capability to innovate, an industrial cluster will soon be on the decline and firms will begin to disperse and relocate to other regions. This capability has to be owned by the firms themselves; public institutions can help, but they cannot replace private efforts.

A cluster may be developed initially by borrowing foreign technologies, but eventually the sustainability of the cluster has to depend on indigenous technologies. Without the indigenous technologies, a cluster can only be an enclave at best. In other words, foreign investment is not enough to create a sustainable industrial cluster. The government has to make sure that indigenous technologies can be accumulated along with the formation of an industrial cluster.

3. Human Resource Development

Human resources are an indispensable ingredient in the formation of an industrial cluster. Although part of human resources can be obtained from abroad, the availability of locally-sourced human resources is crucial to the operations of a cluster. Therefore, investment in human resources is an absolute necessity for any country that is interested in developing an industrial cluster. There is no evidence that training institutions such as universities have to be located near a cluster, but geographical proximity does appear to be useful in terms of facilitating knowledge diffusion. Public institutions devoted to industry-specific training of human resources also prove to be useful in accelerating skill formation in preparation for cluster development.

4. Cross-border linkage

Growth is also a very important element in an industrial cluster. Growth leads to an increase in the number of firms and it drives horizontal differentiation of products. Without significant growth in market demand, a cluster will never emerge. Therefore, a linkage to a growing market is essential to the formation of a cluster. For most developing countries, the major growing markets are often in developed countries, and therefore the ability to export to these markets is critical to the success of an industrial cluster. In this regard, foreign direct investments as well as liberal trade are useful in bringing about the linkage to such export markets. In addition to foreign investment, domestic firms have to be a part of the export drive, making their own linkage to the major markets. Personal connections, such as returning engineers from the major markets, sometimes also help.

5. Facilitation of E-commerce

In the adoption of e-commerce, there are many weaknesses confronted by SMEs. These general barriers to adoption of the Internet are well-known: lack of skilled employees, lack of ease in using technology adapted to SMEs, and also a lack of an awareness of the potential benefits for them. Being more followers than leaders, SMEs seem to need support from public institutions in performing e-business. A series of projects toward e-commerce for SMEs should be launched.

In addition to providing SMEs with information relevant to e-commerce, the government can work with large dominant enterprises to provide technical service, human resource training, and incentives as well as setting up systems to encourage active participation by SMEs. Policy makers need to ensure high quality broadband infrastructures for economic development. The policy of ICT infrastructure cannot be isolated from other business development policies, and especially from cluster-based policies in targeted sectors, such as biotechnology and high technology.

6. Division of labor within an industrial cluster

Vertical disintegration is a norm in industrial clusters. Vertical disintegration allows small-scale specialized suppliers to reap the benefits of economies of scale - an important driving force for agglomeration. There is no apparent effective policy to prompt vertical disintegration in industry. Vertical disintegration is a result of competition and the need to cut production costs through subcontracting and out-sourcing. The only meaningful policy in this regard is to ensure that competitive forces are at work in an industry. In this regards, the government should not attempt to protect incumbent firms or create a situation that brews a monopoly. Even if domestic firms have a dominant position in the global market, it is still useful to make them contestable.

7. Entry of new firms

The prevalence of subcontracting and out-sourcing arrangements in an industrial cluster not only allows specialized suppliers to emerge, but also reduces the cost of entry. As the entry barrier is lowered, more firms will compete in the industry, which drives the dynamic process of clustering. It has been shown that entry barriers are lower in industries that are more geographically concentrated. Therefore, industrial clustering is also useful in promoting competition and incubating SMEs. The government can adopt some proactive policies to attract specialized suppliers in a cluster if such suppliers are absent due to location-specific entry barriers. Any missing links in the production chain tends to limit the development of an industrial cluster, which further impedes potential firms' market entry.